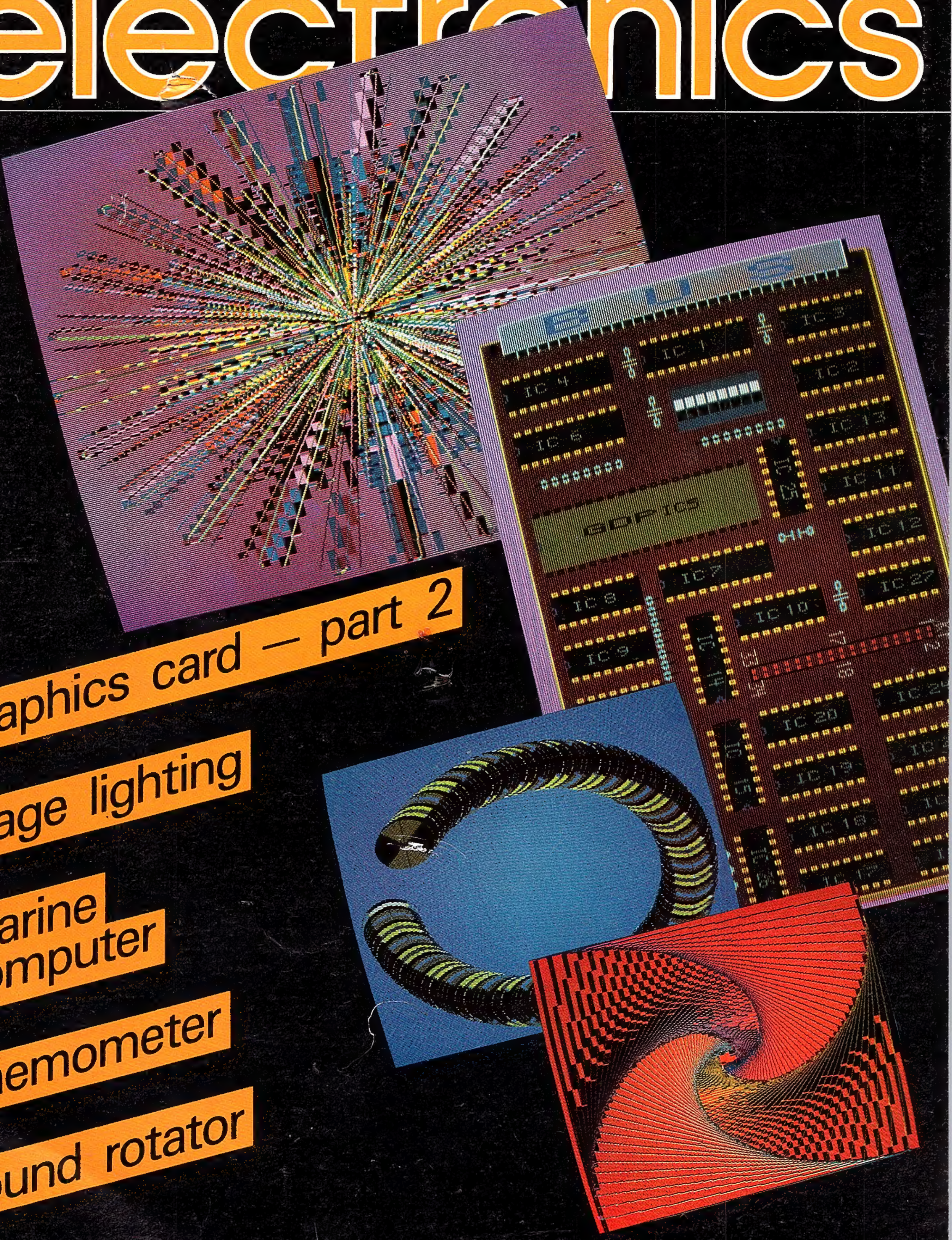
126
October
1985

elektor electronics

20
4p
AT)
$ 3.60

$3.95 R.R.P.



graphics card — part 2

stage lighting

marine computer

anemometer

sound rotator

TTLs

74 SERIES

7400	0.30
7401	0.30
7402	0.30
7403	0.30
7404	0.36
7405	0.30
7406	0.40
7407	0.40
7408	0.30
7409	0.30
7410	0.30
7411	0.30
7412	0.30
7413	0.50
7414	0.70
7416	0.36
7417	0.40
7420	0.30
7421	0.60
7422	0.36
7423	0.36
7425	0.40
7426	0.40
7427	0.32
7428	0.43
7430	0.30
7432	0.36
7433	0.30
7437	0.30
7438	0.40
7439	0.40
7440	0.40
7441	0.90
7442A	0.70
7443A	1.00
7444	1.10
7445	1.00
7446A	1.00
7447A	1.00
7448	1.00
7450	0.36
7451	0.35
7453	0.38
7454	0.38
7460	0.55
7470	0.50
7472	0.45
7473	0.45
7474	0.50
7475	0.60
7476	0.45
7480	0.65
7481	1.80
7483A	1.05
7484A	1.25
7485	1.10
7486	0.42
7489	2.10
7490A	0.55
7491	0.70
7492A	0.70
7493A	0.55
7494	1.10
7495A	0.60
7496	0.80
7497	2.10
74100	1.90
74107	0.50
74109	0.75
74110	0.75
74111	0.55
74116	1.70
74118	1.10
74119	1.70
74120	1.00
74121	0.55
74122	0.70
74123	0.80
74125	0.65
74126	0.55
74128	0.55
74132	0.75
74136	0.70
74141	0.90
74142	2.50
74143	2.70
74144	2.70
74145	1.10
74147	1.70
74148	1.40
74150	1.75
74151A	0.70
74153	0.80
74154	1.40
74155	0.80
74156	0.90
74157	0.80
74159	1.75
74160	1.10
74161	0.80
74162	1.10
74163	1.10
74164	1.20
74165	1.10
74166	1.40
74167	4.00
74170	2.00
74172	4.20
74173	1.40
74174	1.10
74175	1.05
74176	1.00
74178	1.50
74179	1.50
74180	1.00
74181	3.40
74182	1.40
74184	1.80
74185A	1.80
74190	1.30
74191	1.30
74192	1.10
74193	1.15
74194	1.10
74195	0.80
74196	1.30
74197	1.10
74198	2.20
74199	2.20
74221	1.10
74251	1.00
74259	1.50
74265	0.80
74273	2.00
74276	1.40
74278	1.70
74279	0.90
74283	1.05
74285	3.20
74290	0.90
74293	0.90
74298	1.80
74351	2.00
74365A	0.80
74366A	0.80
74367A	0.80
74368A	0.70
74376	1.60
74390	1.10
74393	1.20
74490	1.10
74393	1.20
74490	1.40

74LS SERIES

74LS00	0.24
74LS01	0.24
74LS02	0.24
74LS03	0.24
74LS04	0.24
74LS05	0.24
74LS08	0.24
74LS09	0.24
74LS10	0.24
74LS11	0.24
74LS12	0.24
74LS13	0.34
74LS14	0.50
74LS15	0.24
74LS20	0.24
74LS21	0.24
74LS22	0.24
74LS24	0.50
74LS26	0.24
74LS27	0.24
74LS28	0.24
74LS30	0.24
74LS32	0.24
74LS33	0.24
74LS37	0.24
74LS38	0.24
74LS40	0.24
74LS42	0.50
74LS47	0.80
74LS48	0.90
74LS51	0.24
74LS54	0.24
74LS55	0.24
74LS73A	0.30
74LS74A	0.35
74LS75	0.45
74LS76A	0.36
74LS78	0.42
74LS83A	0.70
74LS85	0.75
74LS86	0.35
74LS90	0.48
74LS91	0.90
74LS92	0.35
74LS93	0.54
74LS95B	0.75
74LS96	0.90
74LS107	0.40
74LS109	0.40
74LS112	0.45
74LS113	0.45
74LS114	0.45
74LS122	0.70
74LS123	0.80
74LS124	1.40
74LS125	0.50
74LS126	0.50
74LS132	0.65
74LS133	0.50
74LS136	0.45
74LS138	0.55
74LS139	0.55
74LS145	0.95
74LS147	1.75
74LS148	1.40
74LS151	0.65
74LS152	2.00
74LS153	0.65
74LS154	1.60
74LS155	0.65
74LS156	0.65
74LS157	0.50
74LS158	0.65
74LS160A	0.75
74LS161A	0.75
74LS162A	0.75
74LS163A	0.75
74LS164	0.75
74LS165A	1.30
74LS166A	1.50
74LS168	1.30
74LS169	1.00
74LS170	1.40
74LS173A	1.00
74LS174	0.75
74LS175	0.75
74LS181	2.00
74LS183	1.90
74LS190	0.75
74LS191	0.75
74LS192	0.80
74LS193	0.80
74LS194A	0.75
74LS195A	0.75
74LS196	0.80
74LS197	0.80
74LS221	0.90
74LS240	0.90
74LS241	0.90
74LS242	0.90
74LS243	0.90
74LS244	0.80
74LS245	1.10
74LS247	1.10
74LS248	1.10
74LS249	1.10
74LS251	0.75
74LS253	0.75
74LS256	0.90
74LS257A	0.70
74LS258A	0.70
74LS259	1.20
74LS260	0.75
74LS261	1.20
74LS266	0.60
74LS273	1.25
74LS279	0.70
74LS280	1.90
74LS283	0.80
74LS290	0.80
74LS292	9.00
74LS293	0.80
74LS295	1.40
74LS297	9.00
74LS298	1.00
74LS299	2.20
74LS231	3.70
74LS323	3.00
74LS324	3.20
74LS348	2.00
74LS352	1.20
74LS353	1.20
74LS356	2.10
74LS363	1.80
74LS364	1.80
74LS365	0.50
74LS366	0.50
74LS367	0.52
74LS368	0.50
74LS373	0.90
74LS374	0.90
74LS375	0.75
74LS377	1.30
74LS378	0.95
74LS379	1.30
74LS381	4.50
74LS390	0.60
74LS393	1.00
74LS395A	1.00
74LS399	1.40
74LS445	1.80
74LS465	1.20
74LS467	1.80
74LS540	1.00
74LS541	1.00
74LS608	7.00
74LS610	19.00
74LS612	19.00
74LS624	3.50
74LS626	2.25
74LS628	2.25
74LS629	1.25
74LS640	2.00
74LS640-1	3.00
74LS641	1.50
74LS642	2.50
74LS642-1	3.00
74LS643	2.50
74LS643-1	3.00
74LS644	3.50
74LS645	2.00
74LS645-1	4.00
74LS668	0.90
74LS669	0.90
74LS670	1.70
74LS682	2.50
74LS684	3.50
74LS687	3.50
74C922	6.00
74C923	6.50
74C925	6.50
74C926	6.50

4000 SERIES

4000	0.20
4001	0.24
4002	0.25
4006	0.70
4007	0.25
4008	0.60
4009	0.45
4010	0.60
4011	0.24
4012	0.25
4013	0.36
4014	0.60
4015	0.70
4016	0.36
4017	0.55
4018	0.60
4019	0.60
4020	0.80
4021	0.60
4022	0.70
4023	0.30
4024	0.48
4025	0.24
4026	0.90
4027	0.40
4028	0.60
4029	0.75
4030	0.35
4031	1.25
4032	1.00
4033	1.25
4034	2.50
4035	0.70
4036	2.50
4037	1.10
4038	1.00
4039	2.50
4040	0.60
4041	0.55
4042	0.50
4043	0.60
4044	0.60
4045	1.00
4046	0.60
4047	0.60
4048	0.55
4049	0.36
4050	0.35
4051	0.65
4052	0.60
4053	0.60
4054	0.80
4055	0.80
4056	0.85
4059	4.00
4060	0.70
4063	0.85
4066	0.40
4067	2.30
4068	0.25
4067	0.24
4068	0.25
4069	0.24
4070	0.24
4071	0.24
4072	0.24
4073	0.24
4075	0.24
4076	0.65
4077	0.25
4078	0.25
4081	0.24
4082	0.25
4085	0.60
4086	0.75
4089	1.20
4093	0.35
4094	0.90
4095	0.90
4096	0.90
4097	2.70
4098	0.75
4099	0.90
4501	0.36
4502	0.55
4503	0.36
4504	0.95
4505	3.60
4506	0.90
4507/4030	0.35
4508	1.20
4510	0.55
4511	0.55
4512	0.55
4513	1.50
4514	1.10
4515	1.10
4516	0.55
4517	2.20
4518	0.48
4519	0.32
4520	0.60
4521	1.15
4522	0.80
4526	0.70
4527	0.80
4528	0.65
4529	1.00
4531	0.75
4532	0.65
4534	3.80
4536	2.50
4538	0.75
4539	0.75
4541	0.90
4543	0.70
4551	1.00
4553	2.40
4555	0.36
4556	0.50
4557	2.40
4560	1.40
4566	1.40
4568	2.40
4569	1.70
4572	0.45
4583	0.90
4584	0.48
4585	0.60
4724	1.50
14411	7.50
14412	7.50
14416	3.00
14419	2.60
14490	4.20
14495	4.50
14500	6.50
14599	2.00
22100	3.50
22101	7.00
22102	7.00
40014	0.48
40085	1.20
40097	0.36
40098	0.40
40100	1.50
40101	1.25
40102	1.50
40103	2.00
40104	1.20
40105	1.50
40106	0.48
40107	0.55
40108	3.20
40109	1.20
40110	2.25
40114	2.25
40147	2.80
40163	1.00
40173	1.20
40174	1.00
40175	1.00
40192	1.00
40193	1.00
40194	1.00
40244	1.50
40245	1.50
40257	1.80
40373	1.80
40374	1.80
80C95	0.75
80C97	0.75
80C98	0.75

Full range of 74S & 74HC series in stock. Ask for full list.

zif sockets

24 pin	5.50
28 pin	7.00
40 pin	8.00

TTL & ECL

10116	70p
10231	350p

LINEAR ICs

AD7581	12.00
ADC0808	11.90
AM7910DC	25.00
AN103	2.00
AY1-5050	1.00
AY3-1350	3.50
AY3-8010	4.50
AY3-8910	4.90
AY3-8912	5.00
CA3019A	1.00
CA3028A	1.10
CA3046	0.70
CA3059	3.20
CA3050	3.50
CA3080E	0.70
CA3086	0.60
CA3089E	2.50
CA3090AQ	3.75
CA3130E	0.90
CA3130T	1.30
CA3140E	0.45
CA3140T	1.00
CA3146	2.25
CA3160E	1.50
CA3161E	2.00
CA3162E	6.00
CA3189E	2.70
CA3240E	1.50
CA3280G	3.00
D7002	6.00
DAC1408-8	3.00
DAC0800	3.00
DAC0808	3.00
DG308	3.00
HA1366	1.90
ICL7106	6.75
ICL7611	0.95
ICL7650	4.00
ICL7660	2.50
ICL8038	4.00
ICM7216B	22.00
ICM7217	7.50
ICM7555	0.90
ICM7556	1.40
LC7120	3.00
LC7130	3.00
LC7431	3.50
LC7137	3.50
LF347	1.20
LF351	0.60
LF353	0.90
LF355	0.90
LF356N	1.10
LF357	1.00
LM10CLH	4.50
LM301A	0.30
LM307	0.45
LM308CN	0.75
LM310	2.25
LM311	0.60
LM318	1.50
LM319	1.80
LM324	0.45
LM334Z	1.15
LM335Z	1.30
LM336	1.60
LM339	0.40
LM348	0.60
LM349CH	3.60
LM358P	0.50
LM377	3.00
LM380N-8	1.50
LM380N	1.50
LM381AN	1.70
LM382	2.00
LM383	3.25
LM384	2.20
LM386N-1	1.00
LM387	2.70
LM389	1.80
LM391	1.80
LM392N	1.10
LM393	0.85
LM394CH	4.00
LM709	0.35
LM710	0.48
LM711	1.00
LM723	0.60
LM725CN	3.00
LM733	0.65
LM741	0.22
LM747	0.70
LM748	0.30
LM1011	4.80
LM1014	1.50
LM1801	3.00
LM1830	2.50
LM1871	3.00
LM1872	3.00
LM1886	6.00
LM1889	4.50
LM2917	3.00
LM3302	0.90
LM3900	0.80
LM3909	1.00
LM3911	1.80
LM3914	3.50
LM3915	3.40
LM3916	3.40
LM13600	1.50
M51513L	2.30
M51516L	4.50
MB3712	2.00
MC1310	1.50
MC1413	0.75
MC1458	0.45
MC1495L	3.00
MC1496	0.70
MC3340	2.00
MC3401	0.70
MC3403	0.65
MF10CN	4.10
MK50240	9.00
MK50398	11.00
ML920	5.00
ML922	4.00
MM66221A	3.00
NE531	1.20
NE555	0.22
NE556	0.60
NE564	4.00
NE565	1.20
NE566	1.50
NE567	1.25
NE570	4.00
NE571	3.00
NE592	0.90
NE5532P	1.50
NE5533P	1.60
NE5534P	1.20
NE5534AP	1.50
OP-07EP	3.50
PLL02A	5.00
RC4136	0.55
RC4151	2.00
RC4195	1.50
RC4558	0.55
S566B	2.20
S50240	9.00
SAA1900	16.00
SFF96364	8.00
SL490	3.00
SN76033N	3.00
SN76489	4.00
SN76495	4.00
SN76660	1.20
SPO256AL2	7.00
TA7120	1.20
TA130	1.40
TA7204	1.50
TA7205	0.90
TA7222	1.50
TA7310	1.50
TBA231	1.20
TBA800	0.80
TBA810	0.90
TBA820	0.80
TBA820M	0.75
TBA920	2.00
TBA950	2.25
TC9109	5.00
TCA210	3.50
TCA220	3.50
TCA940	1.75
TDA1010	2.25
TDA1022	4.50
TDA1024	1.10
TDA1170S	3.00
TDA2002	3.25
TDA2003	1.90
TDA2004	2.40
TDA2006	3.20
TDA2020	3.20
TDA2030	2.50
TDA3810	7.50
TDA7000	3.50
TEA1002	7.00
TL061CP	0.40
TL062	0.60
TL064	0.90
TL071	0.40
TL072	0.70
TL074	1.10
TL081	0.35
TL082	0.55
TL083	0.75
TL084	1.00
TL094	2.00
TL170	0.50
TL430C	1.20
UAA1003-9	9.35
UA759	3.20
UA2240	1.20
UAA170	1.70
UCN4801A	4.00
ULN2003A	0.75
ULN2004A	0.75
ULN2068	2.90
ULN2802	1.90
ULN2803	1.80
ULN2804	1.90
UPC575	2.75
UPC592H	2.00
UPC1156H	3.00
UPC1185H	5.00
XR210	4.00
XR2206	4.00
XR2207	3.75
XR2211	5.75
XR2216	6.75
XR2240	1.20
ZN404	1.00
ZN414	0.80
ZN419P	1.75
ZN423E	1.30
ZN424E	1.30
ZN425E8	3.50
ZN426E8	3.00
ZN427E8	6.00
ZN428E8	4.50
ZN429E8	2.25
ZN447E	9.00
ZN449E	3.00
ZN450E	7.50
ZN459CP	3.00
ZN1034E	2.00
ZN1040	6.60
ZNA134J	23.00
ZNA234E	9.50

CPU's

1802CE	6.50
2650A	10.50
6502	4.50
65C02-2MHz	12.00
6502A	6.50
6502B	8.00
6800	2.50
6802	3.00
6803-2	12.00
6809	6.50
6809E	10.00
68B09	10.00

CPU's

68B09E	12.00
68000-L8	36.00
8035	3.50
80C35	6.00
8039	4.20
80C39	7.00
8080A	4.20
8085A	3.00
80C85A	7.50
8086	22.00
8088	17.50
8741	15.00
8748	16.00
TMS1601	12.00
TMS9980	14.50
TMS9995	12.00
Z80	2.50
Z80A	2.90
Z80B	5.50
Z80H	7.50
70008 (CMOS-Z80)	7.00

SUPPORT DEVICES

2651	12.00
3242	8.00
3245	4.50
6520	3.00
6522	3.50
6522A	5.50
6532	4.80
6551A	6.00
6821	1.50
68B21	2.50
6829	12.50
6840	3.75
68B40	6.00
6850	1.60
68B50	2.50
6852	2.50
6854	6.50
68B54	8.00
6875	5.00
8154	8.50
8155	3.80
8156	3.80
8205	2.25
8212	2.20
8216	1.60
8224	P.O.A.
8226	4.25
8228	5.50
8243	2.60
8250	9.50
8251A	3.25
8253C-5	3.50
8255AC-5	3.20
8256	18.00
8257C-5	4.00
8259C-5	4.00
8275	29.00
8279C-5	4.80
8283	4.00
8282	4.50
8284	4.60
8287	3.80
8288D	9.50
8755A-0/1/2/9	16.00
TMS4500	14.00
TMS9901	5.00
TMS9902	5.00
TMS9911	18.00
TMS9914	14.00
Z80P1O	2.50
Z80AP1O	2.75
Z80CTC	2.50
Z80ACTC	2.75
Z80DART	6.50
Z80ADART	7.00
Z80DMA	7.00
Z80ADMA	7.50
Z80ASIO	7.00
Z80BP10	5.00
Z80BCTC	5.00
Z80BDART	9.00

RAMS

2016-150	4.00
2101	4.00
2102	2.50
2107B	5.00
2111A-35	4.00
2114-3	2.50
2147	4.00
4116-15	2.00
4116-20	1.50
41256-20	7.50
4164-15 (TI)	3.00
4164-15	2.00
4164-20	2.00
4416-15	3.50
4532-20	2.50
4816AP-3	2.00
5101/5501	4.00
5514/5114	4.00
5516	5.00
6116P-3	3.50
6116LP-3	4.00
6264P-15	5.00
6810	1.60
74S189	1.80
74S201	3.50
74S289	2.25
93415	6.00
93L422	7.50
93425	6.00

ROMS/PROMS

28L22	1.00
24S10	2.50
18S030	2.00
18SA030	2.00
74S188	1.80
74S287	2.25
74S288	1.80
74S387	2.25
82S23	1.50
82S123	1.50
82S129	1.75

EE PROM

2816-30 2K × 8	30.00
9306 256 bits (16 × 16)	4.00

EPROMS

2516 + 5V	3.50
2516-35	5.50
2532	4.50
2532-30	5.50
2564	8.00
2708	4.00
2716 + 5V	3.50
2716-35	5.50
2732	4.50
2732A-2	9.00
2732A-30	6.00
2732A-35	5.00
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27128-25	3.50
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CRT CONTROLLER

CRT5027	18.00
CRT6545	9.00
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EF9365	25.00
EF9366	25.00
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MC6845SP	6.50
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TMS9928	10.00
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1.00 MHz	2.70
1.8432 MHz	2.25
2.00 MHz	2.25
2.45760 MHz (S)	2.00
2.5 MHz	2.50
2.662 MHz	2.50
3.12 MHz	1.75
3.276 MHz	1.50
3.5795 MHz	1.00
4.00 MHz	1.40
4.194 MHz	1.50
4.43 MHz	1.00
4.608 MHz	2.50
4.9152 MHz	2.00
5.000 MHz	1.50
5.068	1.75
6.00 MHz	1.40
6.144 MHz	1.40
7.00 MHz	1.50
7.168 MHz	1.75
8.00 MHz	1.50
8.867 MHz	1.75
10.00 MHz	1.75
10.50 MHz	2.50
10.70 MHz	1.50
11.00 MHz	3.00
12.00 MHz	1.50
14.00 MHz	1.75
14.318 MHz	1.60
14.756MHz	2.50
15.00 MHz	2.00
16.00 MHz	2.00
17.734 MHz	1.50
18.00 MHz	1.70
18.432 MHz	1.50
19.969 MHz	1.50
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48.00 MHz	1.75
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FD1797	22.00
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AM26LS32	1.20
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DS8830	1.40
DS8831	1.50
DS8832	1.50
DS8833	2.25
DS8836	1.50
DS8838	2.25
MC1488	0.60
MC1489	0.60
MC3446	2.50
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MC3480	8.50
MC3486	2.25
MC3487	2.25
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MC4044	5.50
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MC14412	7.50
ULN2003	0.75
75107	0.90
75108	0.90
75109	1.20
75110	0.90
75112	1.60
75113	1.20
75114	1.40
75115	1.40
75121	1.40
75122	1.40
75150P	1.20
75154	1.20
75159	2.20
75160	5.00
75161	3.50
75162	4.00
75172	3.00
75182	0.90
75188	0.60
75189	0.60
75365	1.50
75451	0.50
75452	0.50
75453	0.70
75454	0.70
75480	1.50
75491	0.65
75492	0.65
8T26	1.20
8T28	1.20
8T95	1.20
8T96	1.20
8T97	1.20
8T98	1.20
81LS95	1.40
81LS96	1.40
81LS97	1.40
81LS98	1.40
88LS120	3.00
9602	3.00
9636A	1.60
9637AP	1.60
9638	1.90

TELETEXT DECODER

SAA5020	6.00
SAA5030	7.00
SAA5041	16.00
SAA5050	9.00

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AY-3-1015P	3.00
AY-5-1013P	3.00
COM8017	3.00
IM6402	4.50

VOLTAGE REGULATORS

1A FIXED VOLTAGE PLASTIC TO220

+VE			−VE	
5 V	7805	0.45	7905	0.50
6 V	7806	0.50	7906	0.50
8 V	7808	0.50	7908	0.50
12 V	7812	0.45	7912	0.50
15 V	7815	0.50	7915	0.50
18 V	7818	0.50	7918	0.50
24 V	7824	0.50	7924	0.50

1A FIXED VOLTAGE PLASTIC TO92

5 V	78L05	0.30	15 V	78L15	0.30
6 V	78L06	0.30	5 V	79L05	0.45
8 V	78L08	0.30	12 V	79L12	0.50
12 V	78L12	0.30	15 V	17L15	0.50

OTHER REGULATORS		SWITCHING REGULATORS	
LM309K	1.40	ICL7660	2.50
LM323K	3.50	SG3524	3.00
78HO5KC 5 A 5 V	5.75	TL494	3.00
		TL497	3.00
78H12	6.40	78S40	2.50
78PO5	9.00	RC4195	1.50

VARIABLE REGULATORS

LM305AH	2.50	LM723N	0.50
LM317T	1.50	78HGKC	6.50
LM317K	2.40	78GUIC	2.25
LM337T	2.25	79HGKC	6.75
LM350T	4.00	79GUIC	2.50
LM396K	15.00	79MGT2C	1.40

OPTO-ISOLATORS

ILD74	1.30	TIL112	0.70
ILQ74	2.20	TIL113	0.70
MCT26	1.00	TIL116	0.70
MCS2400	1.90	6N137	3.60
MOC3020	1.50	6N139	1.75
TIL111	0.70		

DISPLAYS

FND357	1.00	MAN6610	2.00
FND500/TIL730	1.00	NSB5881	5.70
FND507/TIL729	1.00	TIL311	6.50
MAN74/DL704	1.00	TIL729	1.00
MAN71/DL707	1.00	TIL730	1.00
MAN3640	1.75	MAN8910	1.50
MAN4640	2.00		

DISPLAY DRIVERS

9368	4.50	ULN2004	0.90
9370	4.50	ULN2068	2.90
LM3914	3.50	ULN2802	1.90
LM3915	3.50	ULN2803	1.80
LM3916	3.50	ULN2804	1.90
UDN6118	3.20	75491	0.70
UDN6184	3.20	75492	0.70
ULN2003	0.90		

OTHERS

2N5777	0.50	ORP12	1.20
BPX25	1.80	ORP60	1.20
BPW21	2.80	ORP61	1.20
OCP71	1.80	SFH205	1.00

ATTENTION
ALL PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE

SCRS

1A 50V	70p
5A 400V	50p
8A 600V	140p
16A100V	200p
C106D	45p
MCR101	36p
T1C44	36p
2N3525	130p
2N4444	140p
2N5060/4	40p

ZENERS

2.7V-33V	
400MW	9p
1W	15p

TRIACS

Plastic	
3A 400V	60p
6A 400V	70p
6A 500V	90p
8A 400V	75p
8A 500V	95p
12A500V	105p
16A500V	130p
T 2800D	130p
T1206D	50p
T1226D	70p

DISCRETE DISPLAYS LEDS

125" RED TIL209	0.12
GREEN TIL211	0.16
YELLOW TIL212	0.20
Rect LEDs (R/G/Y)	0.30
CXQ (Bi Colour	1.00
10 LED Bargraph: Red	2.25
Green	2.25
0.2" TIL220	0.15
TIL222	0.18
TIL226	0.22
TIL32	0.55
TIL78	0.55
TIL31B	1.20
TIL81	1.20
TIL100	0.75

LOW PROFILE DIL SOCKETS BY TEXAS

8 pin	9p	18 pin	16p	24 pin	24p
14 pin	10p	20 pin	18p	28 pin	26p
16 pin	11p	22 pin	22p	40 pin	30p

WIRE WRAP SOCKETS BY TEXAS

8 pin	30p	18 pin	50p	24 pin	75p
14 pin	42p	20 pin	60p	28 pin	100p
16 pin	45p	22 pin	65p	40 pin	130p

Turned Pin Low Profile Sockets

8 pin	20p	16 pin	30p	20 pin	40p	28 pin	65p
14 pin	25p	18 pin	35p	24 pin	55p	40 pin	90p

TRANSISTORS

BC107/8	18p	BC557B	18p	BFY50/51	30p	TIP36C	150p	2N3055	55p
BC109B	18p	BC558B	18p	BFY52	30p	TIP41C	50p	2N3442	140p
BC109/C	20p	BC559C	24p	BFY90	90p	TIP42A	60p	2N3702 3	25p
BC141	40p	BCY71	36p	MJ2501	225p	TIP42C	65p	2N3704 5	25p
BC161	40p	BCY72	30p	MJ2955	90p	TIP47	90p	2N3706 7 8	25p
BC177	30p	BD131	75p	MJ3001	225p	TIP54	160p	2N3773	200p
BBC179	30p	BD132	80p	MJE2955	150p	TIP55	180p	2N3819	40p
BC182/L	15p	BD135	40p	MJE3055	125p	TIP125	70p	2N3866	90p
BC184/L	20p	BD136	40p	MPF102	40p	TIP2955	90p	2N3904 6	22p
BC212/L	16p	BD139	40p	MPF103/4	40p	TIP3055	70p	2N4871	50p
BC213/L	16p	BD241B	75p	MPF105	40p	2N2160	350p	2N5245	40p
BC214/L	18p	BD242B	75p	MPSA12	50p	2N2219A	30p	2N5457 8	30p
BC327	16p	BD244B	40p	TIP29C	40p	2N2222A	30p	2N5459	30p
BC338	16p	BF256B	50p	TIP31B	40p	2N2484	30p	2N5485	45p
BC477	36p	BF257/8	40p	TIP31C	45p	2N2646	50p	2N5883	375p
BBC516/7	50p	BF259	40p	TIP32C	45p	2N2905A	30p	2N6027	30p
BBC547/B	20p	BF337	36p	TIP33C	80p	2N3053	36p	3N128	200p
BBC548C	16p	BFR80/81	32p	TIP35C	140p	2N3054	60p	3N140 1	200p
								40673	90p

IDC CONNECTORS

	10 way	20 way	26 way	34 way	40 way	50 way
Header Plug	90p	145p	175p	200p	220p	235p
Receptacle	85p	125p	150p	160p	190p	200p
Edge Conn.	120p	195p	240p	320p	340p	390p

EURO CONNECTORS

	Plug	Socket
DIN 41612 2 - 32-way	300p	350p
angled 2 - 32-way	350p	400p
angled 3 - 32-way	400p	—
(for 2 - 32 way specify a - bor a - c)		
DIN 41617 21-way	160p	165p
DIN 41617 31-way	170p	170p
DIN 41612		
2 × 32 way St Pin	230p	275p
2 × 32 way Ang Pin	275p	320p
3 × 32 way St Pin	260p	300p
3 × 32 way Ang Pin	375p	400p
1 DC Skt A + B	425p	
A + C	425p	

For 2 × 32 way please specify spacing (A + B, A + C)

DIODES

BY127	12p	OA200	9p	IN4003/4	5p
OA47	10p	OA202	10p	IN4006/7	7p
OA90	9p	IN914	4p	IN5401/2	12p
OA91	9p	IN4148	4p	IN5403/4	14p
OA95	9p	IN4001/2	5p	IS920	9p

BRIDGES

1A50V	19p	2A400V	45p	6A100V	100p
1A100V	20p	3A200V	60p	6A400V	120p
1A600V	30p	4A100V	95p	8A100V	150p
2A50V	30p	4A400V	100p	10A100V	180p
2A100V	35p	6A50V	80p	10A400V	200p

MIN D CONNECTORS

	9 way	15 way	25 way	37 way	50 way
		MALE			
solder	60p	85p	1.25p	2.40p	4.00p
angled	1.20p	1.80p	2.40p	3.50p	—
		FEMALE			
solder	90p	1.30p	1.95	2.90p	5.00p
angled	1.60p	2.10p	2.90p	4.40p	—
hood (top/side entry)	90p	85p	90p	1.00p	—

25 way Centronix Type Conn. .... 5.50 pounds
37 way Centronix Type Conn. .... 5.50 pounds
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elektor electronics

October 1985
Volume 11 — Number 126
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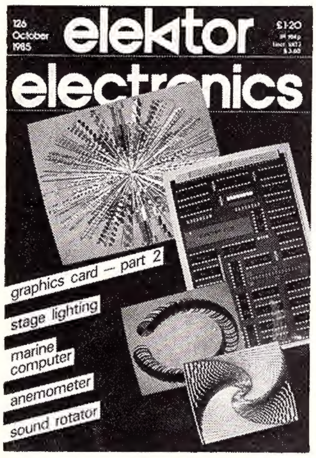

This month's front cover shows the high-definition colour graphics card described in four parts in our September to December 1985 issues, and some typical examples of the displays obtainable with it.

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A selection from our November issue:

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- sweep generator
- stage lighting - 2
- MIDI interface
- graphics card - 3
- car radio amplifier

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OFFICIAL DEALER

ACORN COMPUTER SYSTEMS:

BBC Model B	**£299**	(a)
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BBC Dust Cover	**£4**	(d)
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4816AP Memory upgrade RAM (each)	**£2.00**

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6502 2nd Processor	**£175**	(b)
Teletext Adaptor	**£192**	(a)
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HI VIEW	**£52** (c)
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WORDWISE	**£34** (d)
WORDWISE PLUS	**£49** (d)
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TOOLKIT	**£21** (d)
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MUROM	**£21** (d)

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TERMI II	**£26** (d)
COMMUNICATOR	**£57** (d)
COMMSTAR	**£27** (d)
DATA-BEEB	**£25** (d)

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BCPL Calculations	**£17.30** (d)
BCPL Stand Alone Generator	**£43** (d)

Please write or telephone for details of other ROMs available

In addition to products listed above we stock a wide range of BBC peripherals including: TORCH UNICORN products, GRADUATE the add on that makes the BBC micro IBM compatible, SMARTMOUTH speech synthesiser, TIME WARP Real Time Clock, Colour Graphics Plotter, Graphics Tablet, Video Digitiser, Eprom Programmer etc.

Large selection of business, pleasure and education software including CPM software for the Acorn Z80.

For detailed specification of any of the above equipment please write or telephone.

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Single Drives:

1 × 100K 40T SS	:TS100	**£85 (b)**
1 × 400K 80/40T DS	:TS400	**£125 (b)**

With integral psu:

PS100	**£120 (b)**
PS400	**£145 (b)**

Dual Drives: (with integral psu)

Stacked Version:

PD200 2 × 100K 40T SS	**£190 (a)**
PD800 2 × 400K 80/40T DS	**£265 (a)**

Plinth Versions:

PD200P	**£215 (a)**
PD800P	**£289 (a)**

3.5″ Drives:

The mechanisms are 80 track double sided and are capable of both single and double density operation.

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Dual Disc Cable	**£8.50** (d)
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Please add carriage 50p unless indicated as follows:

(a) £8 (b) £2.50 (c) £1.50 (d) £1.00

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ASCII Keyboard kit	**£75** (b)
J C Books 1, 2, 3, & 4	**£6.90** (c) ea
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Elekterminal Kit (1983)	**£70** (b)

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FX80+ **£315** (a); FX100+ **£430** (a);
LX80NLQ **£242** (a); JX80 Colour **£499** (a)
KAGA TAXAN: KP810 **£245** (a);
KP910 **£339** (a); BROTHER: HR15 **£310** (a);
JUKI 6100 **£299** (a).

ACCESSORIES

BUFFALO 32K Buffer for Epson printers **£75** (d); FX80 plus sheet feeder **£129** (b);
EPSON Serial Interface: 8143 **£28** (b); 8148 with 2K buffer **£57** (b).

EPSON Paper Roll Holder **£17** (b); FX80 Tractor Attach **£37** (b); RX/FX80 Dust Cover **£4.50** (d); LX80 Tractor Unit **£20** (c).

EPSON Ribbons: MX/RX/FX80 **£5**; MX/RX/FX100 **£10** (d); LX80 **£6** (d);

JUKI: Serial Interface **£65** (c); Tractor Attach. **£99** (a); Sheet Feeder **£180** (a); Ribbon **£2.50** (a).

BROTHER HR15: Sheet Feed **£189**; Ribbons - Carbon or Nylon **£4.75**; Multistrike **£5.50** (d); 2000 Sheets Fanfold with extra fine perf. 9.5″ - **£13.50**; 15″ **£17.50** (b).

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ALL MONITORS SUPPLIED WITH LEAD FOR THE BBC

MICROVITEC 14″ RGB

1431 Std Res **£185** (a);
1451 Med Res **£240** (a);
1431AP std Res PAL/Audio **£205** (a);
1451AP Med Res PAL/Audio **£280** (a);
1451DQ3 Med Res for SINCLAIR QL **£239** (a)
1441 Hi Res **£389** (a)
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New Vision III Plus **£360** (a)
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Sanyo DM8112CX **£95** (a)
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PHILIPS DGD Hi Res Green Screen: **£68** (a)
Swivel Stand for Kaga Green with digital clock: **£22.50** (b)
BBC Leads: Kaga RGB **£5** Microvitec **£3.50** Monochrome **£3.50** (c)

SOFTY II

This low cost intelligent eprom programmer can program 2716, 2516, 2532, 2732, and with an adaptor, 2564 and 2764. Displays 512 byte page on TV — has a serial and parallel I/O routines. Can be used as an emulator, cassette interface.

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P9000 Range:

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ABC

Sinclair: any suitors?

Why is it that so many clever and inventive entrepreneurs in this country seem to run into trouble so often? Take Sir Clive Sinclair: entrepreneur and inventor par excellence. But, so far, this year has not been a very good one for him. Starting with a divorce, it then confronted him with a declining home computer market, troubles with the Advertising Standards Authority about the C5 one-man electric car, and a writ claiming more than £1.5 million from Hoover for alleged non-payment of bills.

It all seems rather unfair to a man who has, arguably, contributed more to the computer industry than anyone else since the early 1970s. In fact, it is fairly certain that without him there would never have been so many computer enthusiasts in Britain — or in the rest of the world.

Clive Sinclair started his first company in 1962 while still in his early twenties. Ten years later, Sinclair Radionics launched a pocket calculator which was then almost certainly the smallest, best designed, and cheapest in the world. But fierce and growing competition caused the company to be bailed out some years later by the National Enterprise Board. Within a short time, Clive Sinclair had left the company: was it because he could not — or would not — work within the constraints of an industrial undertaking?

However, this move was the computer world's gain. Within two years, Sinclair had launched the first-ever computer to sell for under £100: the ZX80. Over 100 000 of these were produced. Its successor, the ZX81, was even more successful with sales topping a million worldwide. Even that has been put in the shade by the ZX Spectrum, probably the most successful computer the world will ever see.

But then, a decline set in: neither the hand-held flat-screen TV receiver nor the new QL computer caught on. It seems, however, that the C5 electric car — or rather the £12 million spent on its design? — has done the most damage to Sinclair.

Sinclair has still plenty of ideas, but he needs money to materialize them. There should be sufficient interest from industrial backers for his wafer-scale chips and his compact data-storage device; rather less so for his electric car with a roof.

When, last June, Mr Robert Maxwell proposed a £12 million rescue plan, there were sighs of relief in many quarters of the industry. But, alas, when it was learnt that the stock of computers amounted to no less than £35 million, Mr Maxwell called off the deal.

At the time of writing, no other helping hand has been extended. None the less, there are some glimmers of hope for Sir Clive. The recently merged Dixons/Currys Group have placed a £10 million order for computers and miniature TV sets. At the same time, there are signs that the miniature television receiver may take off at last in earnest — particularly in the USA.

We hope these may prove to be turning points for Sir Clive, but even so, he will need further financial help. We wish him well: he deserves it!

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82n, 100n 11p
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TCA965	180
TDA1008	310
TDA1010	220
TDA1022	400
TDA1024	110
TDA1034	350
TDA1490	350

TDA2002	325
TDA2003	190
TDA2004	230
TDA2006	320
TDA2020	320
TDA2030	190
TDB0701	420
TL170	50
TL497	185
TL507	110
TL509	110
TLO61CP	40
TLO62CP	60
TLO64CN	95
TLO71CP	40
TLO72CP	60
TLO74CN	110
TLO81CP	30
TLO82CP	50
TLO83CP	75
TLO84CN	100
TLO91CP	60
UA2240	120
UA78540	230
UAA170	170
UAA180	180
ULN2003	75
ULN2004	75
ULN2283	150
ULN2803	190
UPC575	275
UPC1025H	375
UPC1156H	295
UPC1181	425
UPC1182	425
UPC1366	195
XR2206	365
XR2207	400
XR2211	575
XR2216	675
XR2266	360
ZN414	80
ZN423E	130
ZN424E	130
ZN425E	350
ZN426E	300
ZN427E	600
ZN428E	450
ZN429E	240
ZN459	245
ZN1034E	200
ZN1040E	665
ZNA234E	925

TRANSISTORS

AD142	120
AD149	79
AD161	42
AD162	42
AF118	80
AF139	40
AF239	55
BC107	12
BC107B	14
BC108	12
BC108B	14
BC108C	14
BC109	12
BC109B	14
BC109C	14
BC114/5	30
BC117/8	25
BC137/9	40
BC140	38
BC142/3	38
BC147	12
BC147B	15
BC148	12
BC148B	15
BC149	12
BC149C	15
BC153/4	30
BC157/8	14
BC159	11
BC160	46
BC167A	14
BC168C	12
BC169C	12
BC170	20
BC171/2	12
BC173	15
BC177/8	16
BC179	20

BC181	30
BC182/3	10
BC184	10
BC182L	10
BC183L	10
BC184L	10
BC186/7	28
BC212	10
BC212L	12
BC213	10
BC213L	12
BC214	10
BC214L	12
BC237/8	15
BC256B	35
BC307B	15
BC308	16
BC318	30
BC327/8	15
BC337/8	15
BC441/61	34
BC477	40
BC516/7	40
BC547/8	12
BC549C	15
BC556/7	15
BC558/9	15
BCY41/42	30
BCY58/59	36
BCY70/71	18
BCY72/78	28
BD121	96
BD124	115
BD131/32	65
BD133	70
BD135	46
BD136/37	40
BD138/39	40

BD140	40
BD158	68
BD205/6	110
BD245	65
BD378	70
BD434	70
BD517	75
BD645	80
BD695/96	15
BF115	45
BF154/8	30
BF167	35
BF173/77	35
BF178/79	40
BF184/5	38
BF194/5	12
BF198/9	18
BF200	80
BF224A	40
BF224B	40
BF245	50
BF256A	45
BF256B	50
BF257/8	32
BF259	40
BF275	55
BF336/7	35
BF494/5	40
BFR39/40	25
BFR41/79	25
BFR80/81	25
BFR98	106
BFX29	35
BFX81	45
BFX85/6	35
BFY50/51	30
BFY52	30
BFY53	35
BFY55/6	35
BFY64	40

BFY81	120
BFY90	80
BFY39	50
BSX20	30
BSX26/29	45
BSY26	35
BSY95	35
BU105	180
BU205	190
BU206	200
BU208	200
BUY69C	225
MJ2955	90
MJE170	150
MJE180	150
MJE340	54
MJE370	100
MJE371	100
MJE520	96
MJE521	96
MJE2955	99
MJE3055	70
MPF102	40
MPF103/4	30
MPF105	30
MPF106	40
MPSA05	30
MPSA08	30
MPSA12	32
MPSA55	30
MPSA56	30
MPSA70	40
MPSU02	58
MPSU05	60
MPSU06	60
MPSU52	65
MPSU55	60
MPSU56	60
TIP29A	32

TIP29C	38
TIP30A	35
TIP30C	37
TIP31A	38
TIP31B	39
TIP31C	45
TIP32A	43
TIP32C	45
TIP33A	70
TIP33C	75
TIP34A	85
TIP34C	105
TIP35A	120
TIP35C	130
TIP36A	130
TIP36C	140
TIP41A	50
TIP41B	52
TIP42A	55
TIP42B	58
TIP120	70
TIP121/2	73
TIP141/2	120
TIP147	120
TIP2955	70
TIP3055	70
TIS44/5	45
TIS88A	50
TIS90/91	30
UC734	65
VK1010	99
VN10KM	70
VN46AF	95
VN66AF	110
VN88AF	120
VN89AF	120
ZTX300	13
ZTX301/2	20
ZTX303	25

ZTX304	17
ZTX314	25
ZTX326	30
ZTX341	30
ZTX451	23
ZTX500	14
ZTX501/2	15
ZTX503	18
ZTX531	25
ZTX550	25
2N697	23
2N698	40
2N699	48
2N707a	25
2N918	40
2N1131/2	40
2N1671b	160
2N2160	325
2N2219a	28
2N2220a	26
2N2221a	26
2N2222	25
2N2368	25
2N2369A	18
2N2483/A	27
2N2646	46
2N2904/5	28
2N2907	28
2N2926	10
2N3053	25
2N3055	50
2N3614	180
2N3702/3	10
2N3819	35
2N3820	60
2N3822	60
2N3904	18
2N3906	18
40673	75

TTL74

7400	25
7401	25
7402	25
7403	25
7404	30
7405	30
7406	40
7407	40
7408	25
7409	25
7410	25
7411	25
7412	25
7413	40
7414	60
7416	35
7417	35
7420	25
7421	50
7422	35
7423	35
7425	35
7426	40
7427	35
7428	35
7430	25
7432	30
7433	30
7437	30
7438	40
7440	30
7441	90
7442	65
7443	100
7444	100
7445	110
7446	110
7447	95
7448	110
7450	30
7451	30

7453	35
7454	35
7460	30
7470	50
7472	50
7473	50
7474	45
7475	55
7476	45
7480	60
7481	175
7482	100
7483	100
7484	110
7485	100
7486	40
7489	200
7490	55
7491	70
7492	110
7493	50
7494	100
7495	60
7496	75
7497	200
74100	60
74104	70
74105	70
74107	45
74109	70
74110	55
74111	55
74116	160
74118	100
74119	160
74120	90
74121	45
74122	65
74123	75
74125	60
74126	55
74128	55
74132	70
74136	65
74141	85
74142	235
74143	250
74144	250
74145	100
74147	160
74148	130
74150	170
74151	60
74153	70
74154	130

74155	75
74156	90
74157	75
74159	170
74160	100
74161	100
74162	100
74163	100
74164	110
74165	100
74166	130
74167	300
74170	190
74172	400
74173	130
74174	100
74175	100
74176	100
74177	110
74178	130
74179	130
74180	100
74181	300
74182	120
74184	170
74185	170
74190	120
74191	120
74192	120
74193	120
74194	100
74195	75
74196	120
74197	100
74198	200
74199	200
74221	150
74246	130
74247	120
74248	145
74249	175

74251	90
74259	150
74265	260
74273	180
74276	130
74278	160
74279	80
74283	100
74284	440
74285	300
74286	90
74290	80
74293	80
74297	175
74298	160
74351	180
74365	70
74366	70
74367	70
74368	70
74376	120
74390	100
74393	100
74425	60
74426	60
74490	100

74C

74C244	150
74C245	150
74C373	180
64C374	425
74C922	550
74C923	600
74C925	650

74S

74S00	45
74S02	40
74S03	40
74S04	40
74S05	40
74S08	40
74S09	40
74S10	40
74S11	50
74S15	60
74S20	40
74S22	60
74S30	50
74S32	50
74S37	50
74S38	70
74S40	40
74S51	40
74S64	40
74S65	40
74S74	70
74S85	295
74S86	100
74S112	100
74S113	100
74S114	100
74S124	300
74S132	90
74S133	50
74S134	60
74S135	110
74S138	170
74S139	170
74S140	75
74S151	140
74S153	140
74S157	200
74S158	190
74S162	300
74S163	300
74S168	300
74S169	300
74S174	250
74S175	300
74S181	£11
74S182	250
74S188	180
74S189	225
74S194	280
74S195	320
74S196	395
74S197	300
74S201	250
74S225	500
74S226	350
74S240	375
74S241	375
74S244	475
74S251	225
74S257	225

74S258	225
74S260	70
74S262	£10
74S274	£10
74S275	£10
74S280	425
74S281	885
74S283	295
74S287	200
74S288	180
74S289	200
74S299	595
74S301	350
74S365	250
74S373	375
74S374	375
74S381	550
74S412	380
74S470	325
74S471	600
74S472	400
74S474	400
74S475	425
74S571	300
74S573	450

74LS

74LS00	25
74LS01	25
74LS02	25
74LS03	25
74LS04	25
74LS05	25
74LS08	25
74LS09	25
74LS10	25
74LS11	25
74LS12	25
74LS13	35
74LS14	50
74LS15	25
74LS20	25
74LS21	25
74LS22	25
74LS24	50
74LS26	25
74LS27	25
74LS28	25
74LS30	25
74LS32	25
74LS33	25
74LS37	25
74LS38	25
74LS40	25
74LS42	50
74LS47	80
74LS48	90
74LS49	100
74LS51	25
74LS54	25
74LS55	25
74LS63	55
74LS73	30
74LS74	35
74LS75	45
74LS76	40
74LS78	40
74LS83	70
74LS85	70
74LS86	35
74LS90	50
74LS91	90
74LS92	55
74LS93	55
74LS95	70
74LS96	90
74LS107	40
74LS109	45
74LS112	45
74LS113	40
74LS114	40
74LS122	70
74LS123	80
74LS124	125
74LS125	50
74LS126	50
74LS132	60
74LS133	50
74LS136	45
74LS138	60
74LS139	60
74LS145	95
74LS147	165
74LS148	130
74LS151	70
74LS153	70
74LS154	155

74LS155	7
74LS156	7
74LS157	6
74LS158	6
74LS160	7
74LS161	7
74LS162	7
74LS163	7
74LS164	7
74LS165	11
74LS166	15
74LS168	14
74LS169	10
74LS170	14
74LS173	10
74LS174	7
74LS175	7
74LS181	1
74LS183	1
74LS190	8
74LS191	8
74LS192	8
74LS193	8
74LS194	7
74LS195	7
74LS196	8
74LS197	8
74LS221	8
74LS240	8
74LS241	8
74LS242	9
74LS243	9
74LS244	8
74LS245	1
74LS247	1
74LS248	1
74LS249	1
74LS251	
74LS253	
74LS256	
74LS257	
74LS258	
74LS259	1
74LS260	
74LS261	1
74LS266	
74LS273	1
74LS275	3
74LS279	
74LS280	1
74LS283	
74LS290	
74LS293	
74LS295	1
74LS297	8
74LS298	1
74LS299	2
74LS320	2
74LS323	4
74LS324	1
74LS347	1
74LS348	1
74LS352	1
74LS353	1
74LS356	2
74LS363	1
74LS364	1
74LS365	
74LS366	
74LS367	
74LS368	
74LS373	
74LS374	
74LS375	
74LS377	
74LS378	
74LS379	
74LS384	
74LS385	
74LS386	
74LS390	
74LS393	
74LS395	
74LS398	
74LS399	
74LS447	
74LS465	
74LS490	
74LS540	
74LS541	
74LS624	
74LS629	
74LS640	
74LS641	
74LS645	
74LS668	
74LS669	
74LS670	
74LS673	
74LS674	
74LS682	
74LS684	
74LS687	

74 HC

HC00	55
HC02	55
HC04	55
HC08	55
HC10	55
HC20	55
HC32	55
HC42	135
HC51	55
HC74	70
HC86	60
HC107	70
HC109	75
HC139	120
HC153	135
HC160	35
HC161	135
HC164	135
HC165	270
HC173	120
HC174	120
HC175	120
HC240	195
HC241	195
HC242	135
HC244	195
HC245	195
HC259	270
HC373	225
HC374	225
HC393	225
HC640	240
HC645	240

SWITCHES

Toggle: 2 A, 250 V	
SPST	35p
DPDT	48p

SUB-MIN-TOGGLE

SPST on/off	58p
SPDT c/over	64p
SPDT centre off	85p
SPDT biased both ways	105p
DPDT 6 tags	80p
DPDT centre off	88p
DPDT biased both ways	145p
DPDT 3 positions' n/on/on	185p
-pole 2 way	220p

LIDE 250 V:

PDT 1 A	14p
PDT 1 A c/off	15p
PDT ½ A	13p

USHBUTTON
A
ith 10 mm Button

PDT latching	150p
PDT latching	200p
PDT moment	200p

lini Non Locking

ush to Make	15p
ush to Break	25p

DIGITAST
SWITCHES
Assorted
colours
75p each

DIL SWITCHES

(SPST) 4 way **65p** 6 way **80p**
8 way **85p** 10 way **100p**
(SPDT) 4 way **190p**

ROTARY SWITCHES

(Adjustable Stop type)
1 pole/2 to 12 way; 2p/2 to 6 way:
3 pole/2 to 4 way; 4p/2 to 3 way **48p**

ROTARY: Mains: DP 250 V
4 Amp on/off **68p**

ROTARY: (Mak-a-Switch)
Make a multiway switch. Shafting assembly has adjustable stop. Accommodates up to 6 wafers (max. 6 pole/12 way + DP switch).
Mechanism only **90p**

WAFERS: (make before break)
to fit the above switch mechanism.
1 pole/12 way; 2 pole/6 way;
3 pole/4 way; 4 pole/3 way;
6-/2 way **65p**
Mains DP 4A Switch to fit **45p**
Spacers **4p**. Screen **8p**

ROCKER SWITCHES

ROCKER: 5A/250V SPST	28p
ROCKER: 10A/250V SPDT	38p
ROCKER: 10A/250V DPDT c/off	95p
ROCKER: 10A/250V DPST with neon	85p

THUMBWHEEL SWITCH
Mini front mounting

Decade Switch Module	275p
B.C.D. Switch Module	298p
Mounting Cheeks (per pair)	75p

VERO
a. vero board.
b. vero wiring board.
c. ferric chloride.
d. proto dec's.
e. dalo petch resist pen.
f. ultrasonic transducers.

a. VERO BOARDS 0.1"

2½ × 1	30p
2½ × 3¾	95p
2½ × 5	110p
3¾ × 3¾	110p
3¾ × 5	125p
3¾ × 17	420p
4¾ × 17	590p
VQ Board	195p
DIP Board	395p
Vero Strip	95p

b. VERO PINS per 100

Single Ended	55p
Double ended	60p
Wire Wrap S/E	155p
Wire Wrap D/E	255p

c. VERO WIRING

PEN + Spool	380p
Spare spool	75p
Combs	8p
Pen + Spool + Combs	599p

d. PROTO DECs

Veroblock	480p
S-Dec	350p
Eurobreadboard	590p
Bimboard	575p
Superstrip SS2	1350p

e. VERO TOOLS

Spot face cutters	150p
Pin insertion tool	185p

f. DALO ETCH RESIST PEN
Plus spare tip ... 100p

g. FERRIC CHLORIDE
1 lb bag Anhydrous
125p + 50 p&p

COPPER CLAD BOARDS

Fibre glass	Single-sided	Double-sided
6" × 6"	100p	125p
6" × 12"	175p	225p

DIL SOCKETS

	Low Prof	Wire Wrap
8 pin	8p	25p
14 pin	10p	35p
16 pin	10p	42p
18 pin	16p	52p
20 pin	20p	60p
22 pin	22p	65p
24 pin	25p	70p
28 pin	28p	80p
40 pin	30p	99p

EDGE CONNECTORS

	.1"	.156"
2 × 6 way	—	75p
2 × 12 way	—	160p
2 × 15 way	—	165p
2 × 18 way	175p	160p
2 × 22 way	200	170p
2 × 23 way	150p	—
2 × 25 way	250p	245p
2 × 28 way	180p	—
2 × 30 way	280p	—
2 × 36 way	300p	—
2 × 40 way	320p	—
2 × 43 way	400p	—
2 × 75 way	600p	—

IDC CONNECTORS

PCB Plugs with latch	Pins Strt	Pins Angle	Female Header Plug	Female Card Edge Connect
10 way	90p	99p	85p	120p
16 way	130p	150p	110p	—
20 way	145p	166p	125p	195p
26 way	175p	200p	150p	240p
34 way	200p	236p	169p	320p
40 way	220p	250p	190p	340p
50 way	236p	270p	200p	350p
60 way	—	—	230p	495p

EURO CONNECTORS

	Female Strt. Pins	Socket Angle Pins	Male Strt Pins	Plug Angle Pins
DIN41617 31 way	125p	—	—	175p
DIN41612 2 × 32 A + B	200p	—	175p	220p
DIN41612 2 × 32 A + C	225p	—	185p	230p
DIN41612 3 × 32 A + B + C	280p	290p	295p	300p

DIL PLUG (Header)

	Solder	IDC
14pin	40p	95p
16pin	45p	100p
24pin	85p	135p
28pin	150p	200p
40pin	200p	225p

RIBBON CABLE
price per foot

	Grey	Colour
10 way	15p	28p
16 way	25p	40p
20 way	30p	50p
24 way	40p	65p
28 way	55p	80p
34 way	60p	85p
40 way	70p	90p
50 way	85p	110p
64 way	100p	135p

ZIF TEXTOOL DIL SOCKETS

24 pin	575p
28 pin	695p
40 pin	845p

PANEL METERS
FSD
60 × 46 × 35mm
0-50μA
0-100μA
0-500μA
0-1mA
0-5mA
0-10mA
0-50mA
0-100mA
0-500mA
0-1A
0-2A
0-25V
0-50V AC
0-300V AC
"S"
"VU"
465p each

CRYSTALS

32.768KHz	100
100KHz	400
200KHz	370
455KHz	370
1MHz	265
1.008M	275
1.28MHz	450
1.5MHz	525
1.6MHz	595
1.8MHz	545
1.8432M	220
2.0MHz	225
2.4576M	200
3.278M	150
3.5794M	96
3.6864M	300
4.0MHz	150
4.032MHz	290
4.194304M	200
4.433619M	100
4.80MHz	200
5.0MHz	150
5.185MHz	300
5.24288M	390
6.0MHz	140
6.1441MHz	140
6.5536MHz	225
7.0MHz	150
7.168MHz	175
7.68MHz	200
8.0MHz	150
8.08333M	395
8.86723M	175
9.00MHz	150
10.0MHz	175
10.24MHz	200
10.7	150
12.0MHz	150
12.528M	300
14.31814M	155
15.0MHz	200
16.0MHz	200
18.0MHz	150
18.432M	150
20.0MHz	150
19.968MHz	150
24.0MHz	150
24.930MHz	325
26.69M	150
27.648M	170
27.145M	190
38.66667M	175
48.0MHz	170
100.0MHz	295

RELAYS

Miniature, enclosed, PCB mount.
SINGLE POLE Changeover
RL6-91 205 Ω Coil; 12V DC (10V5 to 19.5 V). 10 A at 30 V DC or 250 V AC **185p**
DOUBLE POLE Changeover. 6 A
30 V DC or 250 V AC
RL-113 53 Ω Coil, 6 V DC (5V4 to 9V9) **190p**
RL6-111 205 Ω Coil, 12 V DC (10V7 to 19V5) **195p**
RL6-114 740 Ω Coil, 24 V DC (22V to 37 V) **200p**

ASTEC UHF MODULATORS
6 MHz Standard **375p**
8 MHz Wideband **450p**

BUZZERS, miniature, solid state
6V; 9V & 12V **70p**

PIEZO TRANSDUCERS
PB2720 **60p**

ULTRASONIC TRANSDUCERS
40 kHz .... **475p** pr.

LOUDSPEAKERS
Miniature, 0.3W: 8Ω
2in, 3¼in, 2½in, 3in **80p**
2½in, 40Ω, 64Ω or 80Ω **80p**

MONITORS

- Zenith — 12" Green or amber, Hi-Resolution Popular **£66**
- MICROVITEC 1451, Med-Res, 14" Colour RGB input. Connecting Cable incl. **£237**
- KAGA 12". Med-Res. RGB. Colour. Has flicker-free characters. Ideal for BBC, Apple, VIC, etc. **£225** (car.7)
- KAGA 12". As above but Hi-Resolution **£310** (car.7)
- Connecting Lead for KAGA **£5**
- Carriage **£7** securicor.

ANSFORMERS
-3V; 6-0-6V; 9-0-9V; 12-0-12V; 15-0-15V
100 mA **130p**
B mounting; Miniature; Split Bobbin
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3A; 2 × 15V /0.25A **250p**
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A5; 2 × 15V /0A4; 2 × 20V /0A3
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VA: 2 × 6V /1A5; 2 × 9V /1A2; 2 × 12V
A; 2 × 20V /0A5 .... **385p** (60p P&P)
VA: 2 × 6V /4A; 2 × 9V /2A5; 2 × 12V
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Viewdata in Britain

The 1000 viewdata terminals recently ordered by a major British financial services company were the most impressive example yet of the spread of the medium into everyday use in the United Kingdom. Viewdata has ceased to be a monolothic product, and is now tailored to a series of individual marketplaces such as travel and tourism, stock ordering, financial data, and software downloading where its essential virtues of simplicity, networking, and colour recommend it to non-specialist users.

Prestel, the viewdata system operated by British Telecom, is the largest of the private viewdata systems.

There are other systems too that have always been operated by private companies, such as British Leyland's (BL) car sales system, operated by its computer bureau company Istel. Then there are hybrids of the two, based on private computers but connected to the Prestel network via a gateway computer link. Several major British tour operators have arrangements of that kind and so far, Prestel has 18 such external gateways in operation.

New markets

So it is a mistake to equate United Kingdom viewdata with Prestel alone, just as it is wrong to condemn as unrealistic the original, over-optimistic forecasts of five years ago for the spread of Prestel to every home. The fact is that in Britain Prestel and viewdata in general have long since turned to different markets and marketing objectives. It is on these that the technology should be judged.

Prestel itself continues to grow. At the last count it had 48000 terminals attached to its network and a database of over 330 000 frames of information (that is, screenfuls) on its computers. Despite the evident tribulations of its early years, it has been adding about 10 000 new subscribers a year, and there are now signs of a demand by the private as well as the business user.

Of the total number of terminals, 41 per cent are now in homes, against 14 per cent in 1982. However, it is a fair assumption that the revenues are still far more biased towards business user.

Prestel has had some notable innovations in the past 18 months:

- Its Mailbox electronic mail service went national, after a trial period in London. Some 40 000 messages are now being sent each week, a figure that has been growing by 12 per cent weekly.
- Prestel Farmlink was launched, giving both local and national information, for example on crop problems, weather, market prices and pest warnings. Through gateways to other computers, the farmer can perform wages calculations and ration formulation analysis.
- A nationwide theatre ticket booking service was inaugurated by a leading London ticket agency, Edwards and Edwards.
- Prestel Homefinder was launched specifically for estate agents to exchange details of houses for sale.

Home Computers

Perhaps the most successful single service so far has been Prestel Microcomputing, based on subscriptions for which home computer owners can download* games and other software. In association with two telesoftware suppliers, Micronet 800 — the most popular single information provider (IP) out of Prestel's 160 contracted IPs — and Viewfax 258, this service has attracted about 10 000 subscribers.

This figure, while proof of the appeal of the service, is still only a small fraction of the United Kingdom's three million home computer owners, and it will be a test of the recent £250 000 television and press marketing campaign for Prestel telesoftware to see whether this customer base can be substantially enlarged.

These developments are in addition to the Homelink telebanking service whose software has been sold to the Commonwealth Bank of Australia; the Citiservice of stock exchange, commodity market and other real time prices that has been running for several years; and the extensive travel trade information that has characterized Prestel since its inception, with 5400 British travel agencies now using the service.

Prestel has found a more modest — but commercially more realistic — place than was originally anticipated in the British market for electronic information systems. But in assessing it, it is necessary to recognize its wider impact:

Achievements

- It has created a more variegated United Kingdom market for viewdata.
- It has produced technical standards and standardization that have made it possible for viewdata as a mode of computing to spread to many new areas.
- It has triggered interest in viewdata in almost all industrialised countries. Many of them, through their national telecommunications authorities (PTTs), have now adopted it as part of their own systems.
- It was and is a test-bed for many new telecommunications services which are now standard parts of the value added services business, such as electronic mail, tele-ordering, gateways, and downloading.
- It has blazed the trail for British Telecom as an information and value added services company, rather than a passive common carrier.

Other countries experience viewdata

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*A downloader is a relatively inexpensive program that converts the data from the computer being consulted into a suitable form for the receiving (home) computer. Downloaders are commercially available for a number of popular computers, such as the BBC micro, Sinclair Spectrum, Amstrad, C64, Electron, IBM, Apple, etc.

1

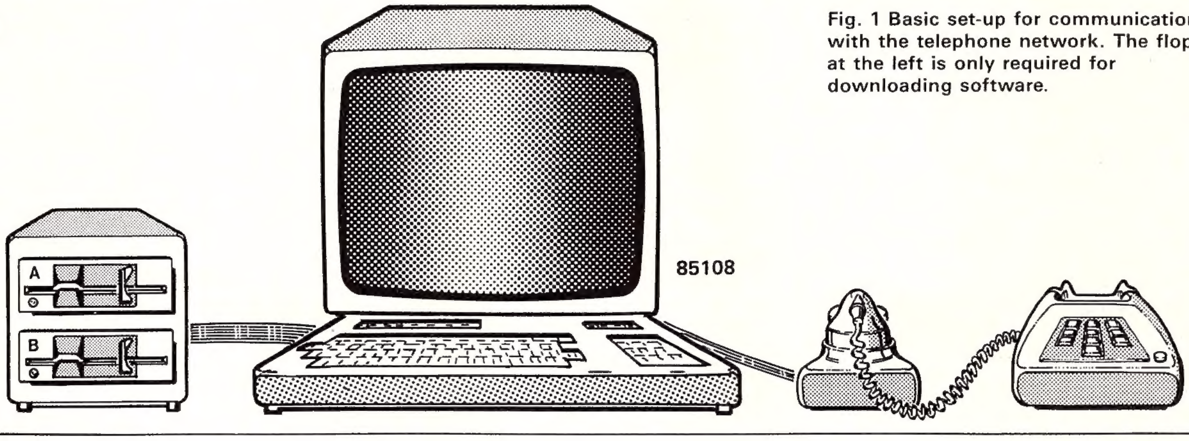

Fig. 1 Basic set-up for communication with the telephone network. The floppy at the left is only required for downloading software.

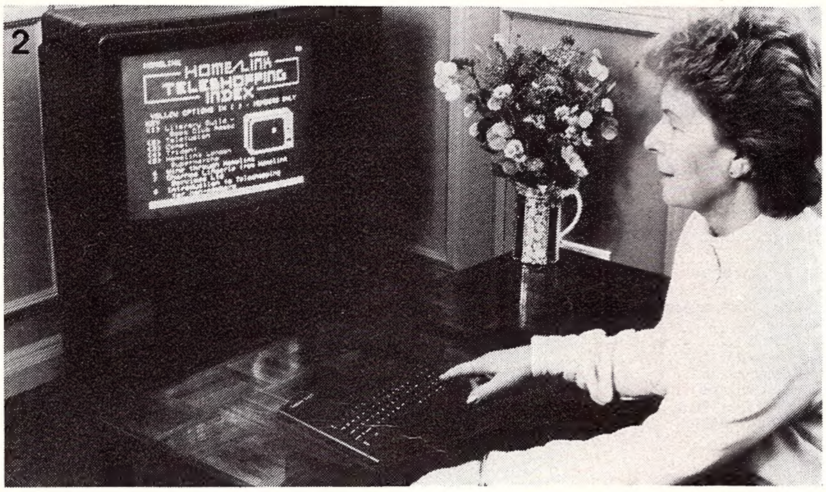

Fig. 2 Through Prestel's Homelink system, customers can order, and pay for, goods in the shops from the comfort of their own homes.

differently. France has designed its own system, technically incompatible with Prestel, and has made it the cornerstone of its **telematics** programme.

Based on small black and white Minitel terminals, the basic viewdata network is being created as a nationwide electronic telephone directory, replacing paper directories in the home and office. This is an imaginative but expensive approach, because it has to be heavily subsidized by the PTT.

About 300 000 Minitels are now in use, and over a million more are on order. The long run objective is that many other electronic information and transaction services will be offered over the network, and, as in the United Kingdom, there is early evidence of business rather than domestic usage of the system, such as in banking.

Substantial Use

West Germany has not taken the electronic telephone directory route, but has commissioned IBM to supply a nationwide viewdata system derived originally from Prestel. This has suffered technical delays, but has now been formally launched.

Forecasts of its growth (as with Prestel in its early years) have varied enormously, although the West German PTT, the Bundespost, is saying that it will have one million customers by the end of 1986. Others think it may be a fifth of that figure.

But it seems clear that in West Germany, as in France, viewdata will achieve substantial use, thanks to the impetus given to it by the national PTT.

The British viewdata marketplace is not so unified. Alongside and intermingled with Prestel are the private systems, often operated by major trading companies. Examples are the information networks for dealers operated by two major motor manufacturers, or the stock control system operated by the Debenhams department store group.

Other systems are run by large computer bureau houses such as Thorn EMI's subsidiary, Datasolve. This has several tele-ordering services operating through a Prestel gateway, notably Reservision for hotel reservations and Teleordering for the book trade.

Drugs and Banks

In another area, the Baric computer bureau has been helping to conduct clinical trails of new drugs, by using viewdata as a way of collecting and collating test information from doctors taking part in the trials.

Barclays Bank has its own in-house staff training scheme using viewdata screens, and the Bankers Automated Clearing Service (BACS) is using a private system supplied by Rediffusion to cope with the problem of redirecting back to its client banks queries that arise out of the millions of banking transactions processed electronically.

The Bank of Scotland, in conjunction with Prestel, has been operating a Home Banking service throughout the UK since last year.

This service enables private and business customers to check any aspect of their accounts, pay bills, and transfer money seven days a week, virtually round the clock.

There is also a special Home & Office Banking Investment Account: a high-interest bank account into which funds can be put that are not required for immediate use.

Armchair shopping

Club 403, an "armchair shopping service" operated by Viewtel Services Ltd from Birmingham, could be adapted for use in Australia, New Zealand, Canada and the USA.

Potential purchasers from these countries have been among the overseas visitors to Club 403 during its two-year trial with 1000 members. Following successful completion of the market test, Club 403 is now operating on a commercial basis in conjunction with Prestel.

The service is aimed at people who do not have the time or transport to visit the supermarket themselves, and for the elderly or disabled for whom shopping is physically impossible.

Club 403 is a package of regularly updated news, information and services available for the consumer at home. Using the latest technology a specially equipped television set can access all kinds of local, national, and international news and order and pay for a wide range of goods and services. Club 403 members talk back to the information source to order goods or services by way of a simple alphanumeric keyboard.

Services available include: armchair grocer, butcher, greengrocer, teleflorist, telebetting, telebanking, gourmet food service, electronic cookbook, motoring, gardening, education, jobs, library enquiries, and news pages.

The most popular service is the "armchair grocer" which provides details of almost 10 000 products from a local hypermarket. A catalogue is issued to members listing the available products with an individual code number.

A member selects the items she wishes to order by keying in the appropriate code. A shopping list of goods required on a regular basis can be stored on the computer and used every time. Goods ordered are confirmed by products description, price, and quantity on the television screen. The orders are received by the hypermarket, printed out, and sorted into a picking order to speed the collection of goods for packing. The grocery order is then despatched to the member's home.

It is fair to observe that in the United States of America, where other styles of computer networking have become firmly established, the European idea of viewdata has not yet caught on. Viewtron, a service begun in Florida, has had to lay off staff after a poor take-up. It is also true that Canada has not had much commercial success with its own viewdata design, known as Telidon, which is strong on graphics but very expensive.

It would be false, therefore, to pretend that viewdata or any other form of electronic information system will meet all home and business needs. The results of using such a system will also vary from country to country. But what has been shown by Prestel and viewdata generally is that it has a rightful place among the technologies of the electronic information era.

(LPS)

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ELEKTERMINAL + elekterminal 1 x 2716 EPROM	517	8.40	16.75
morse program for the Junior Computer 1 x 2716 EPROM	518	8.40	16.75
telex program for the Junior Computer 1 x 2716 EPROM	519	8.40	16.75
ASCII keysoft 1 x 2716 EPROM	520	8.40	16.75
character generator and video routines for DOS Junior 1 x 2732 + 1 x 2716 EPROMS	521	18.90	37.75
character generator and video routines for extended Junior 1 x 2732 + 2 x 2716 EPROMS	522	27.30	54.50
character generator 1 x 2732 EPROM	523	10.50	21.00
quantisizer 1 x 2716 EPROM	524	8.40	16.75
universal terminal 1 x 2732 EPROM	525	10.50	21.00
wind direction indicator 1 x 2716 EPROM	526	8.40	16.75
elabyrinth 1 x 2716 EPROM	527	8.40	16.75
EPROM copier 1 x 2716 EPROM	528	8.40	16.75
analytical video display 1 x 82S23 EPROM	529	10.50	21.00
typewriter interface 2 × 2716 EPROM	530	16.80	33.50
µP-controlled frequency meter 1 × 2732 EPROM	531	10.50	21.00
X-Y plotter 1 × 2732 EPROM	532	10.50	21.00
programmable timer 1 × 2732 EPROM	535	10.50	21.00
GHz pre-scaler 1 × 2732 EPROM	536	10.50	21.00
automate your model railway 1 × 2716 EPROM	537	10.50	21.00
marine computer 1 × 2716 EPROM	538	10.50	21.00

PRINTED CIRCUIT SERVICE

The following list shows the printed circuits pertaining to projects published within the last six months and which are currently available.

	No.	£	$
APRIL 1985			
real-time clock	84094	6.70	13.50
first cuckoo in spring	85016	4.70	9.50
X-Y plotter	85020	12.50	25.00
light-powered radio	85042	3.00	6.00
revolution counter	85043	6.10	12.25
10 A power supply	85044	6.75	13.50
MAY 1985			
programmable timer	85047-1	7.10	14.25
	85047-2	7.10	14.25
glow plug modulator	85053	3.40	6.75
automonitor	85054	4.40	8.75
universal I/O bus	85058	10.10	20.25
digitizer	85063	4.10	8.25
JUNE 1985			
tone burst generator	85057	2.90	5.75
infra-red movement detector	85064	7.35	11.00
RAM used as EPROM	85065	2.80	4.25
autoservice timer	85072	8.90	13.25
JULY/AUGUST 1985			
jumbo displays	85413-1	12.40	24.75
	85413-2	4.90	9.75
	85413-3	3.70	7.50
audio tester	85423	3.55	7.00
hi-fi headphone amplifier	85431	3.35	6.75
lead-acid battery charger	85446	2.75	5.50
improved logic probe	85447	2.50	5.00
light barrier	85449	4.35	8.75
microphone pre-amplifier with mute switch — symm.	85450-1	3.05	6.00
— asymm.	85450-2	2.95	5.75
discomixer	85463	11.85	23.75
6502 tracer	85466	2.85	5.75
sound-level-indicator	85470-1	4.05	8.00
	85470-2	6.55	13.00
twin dimmer	85480	2.75	5.50
model railway monitor panel	85493	3.70	7.50
SEPTEMBER 1985			
RS232 interface	85073	3.95	6.00
solid-state relay	85081	2.15	3.25
intruder alarm	85089-1	8.25	12.50
	85089-2	2.45	3.75
frequency standard	85092	4.00	6.00
OCTOBER 1985			
hand-held anemometer	85093	9.70	14.50
stage lighting	85097-1	6.15	9.25
	85097-2	6.35	9.50
sound rotator	85099	5.70	8.50

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* In limited supply only; their availability at the time your order is received cannot be guaranteed.

readers' services

PRINTED CIRCUIT SERVICE

The following list is complementary to the one on the opposite page and shows the printed circuits relating to projects which were published more than six months ago. Those marked with an asterisk are in limited supply only and their availability at the time your order is received cannot be guaranteed.

	No.	£	$
OCTOBER 1978			
VHF/UHF modulator	9967*	2.10	4.25
DECEMBER 1978			
elekterminal	9966*	9.90	19.75
SEPTEMBER 1979			
parametric equalizer			
tone control section	9897-2*	2.20	4.50
NOVEMBER 1979			
busboard	80024	7.70	15.50
MAY 1980			
Junior computer			
main board	80089-1*	16.60	33.25
display board	80089-2*	1.80	3.50
supply board	80089-3*	4.00	8.00
FEBRUARY 1981			
voiced/unvoiced detector			
detector board	81027-1*	3.60	7.25
switch board	81027-2*	4.30	8.50
JUNE 1981			
Junior Computer			
12 V supply	81033-2*	1.90	3.75
adaptor board	81033-3*	1.70	3.50
SEPTEMBER 1981			
disco light controller	81155*	4.20	8.50
DFM + DVM	81156*	5.60	11.25
revolution counter	81171*	6.40	12.50
NOVEMBER 1981			
power supply	9968-5A	1.90	3.75
high boost	82029*	2.50	5.00
DECEMBER 1981			
70 cm transverter (Oct.)	80133	16.50	33.00
VHF/UHF converter board	9864	2.30	4.50
flashing light	82038*	2.10	4.25
JANUARY 1982			
electronic chimes	82046*	2.10	4.25
FEBRUARY 1982			
universal NiCad charger	82070	2.80	5.50
APRIL 1982			
dynamic RAM card	82017	10.00	20.00
100 W amplifier	82089-1*	3.40	6.75
mini EPROM card	82093*	2.20	4.50
MAY 1982			
Z80-A CPU card	82105	9.30	18.50
JUNE 1982			
car alarm	82091*	3.00	6.00
electronic fluorescent light starter	82138*	1.80	3.50
SUMMER CIRCUITS 1982			
light-sensitive switch	82528*	2.10	4.25
5 V power supply	82570	2.90	5.75
E89: SEPTEMBER 1982			
darkroom computer part I			
keyboard	82141-1	4.90	9.75
keyboard interface	82141-2*	2.70	5.50
display	82141-3	3.00	6.00
three phase tester	82577	3.50	7.00
OCTOBER 1982			
darkroom computer part II			
light meter	82142-1	2.30	4.50
temperature meter	82142-2	2.10	4.25
process timer	82142-3	2.70	5.50
wave shifter for SSB:			
low frequency converter	82161-1	2.70	5.50
high frequency converter	82161-2	3.00	6.00
NOVEMBER 1982			
model train lighting	82157	5.40	10.75
DECEMBER 1982			
precision power supply	82178	5.30	10.50
triopodus electrus diclopus	82179	3.90	7.75
crescendo	82180	6.10	12.25
JANUARY 1983			
3 A computer power supply	83002	2.40	4.75
milli-ohmmeter	83006	2.50	5.00
crescendo d.c. protection and countdown	83008	4.00	8.00
FEBRUARY 1983			
Prelude			
headphone amplifier	83022-7*	5.40	10.75
power supply	83022-8*	4.90	9.75
connection board	83022-9*	7.80	15.50
main beam dimmer	83028	2.00	4.00
MARCH 1983			
64 k memory card	83014	7.80	15.50
Prelude			
bus board	83022-1*	15.20	30.50
line amplifier	83022-6*	6.30	12.50
audio trafic lights	83022-10*	2.80	5.50
digital luxmeter	83037	2.70	5.50
APRIL 1983			
programmable darkroom timer	82048	5.50	11.00
Prelude			
MC prepreamplifier	83022-2*	5.30	10.50
MM preamplifier	83022-3*	6.50	13.00
Interlude remote control preamp	83022-4*	4.90	9.75
tone control	83022-5*	5.10	10.25
7-day timer/controller	83041	5.70	11.50
MAY 1983			
Maestro	83051-1	2.70	5.50
Watt meter	83052*	3.80	7.50
morse converter	83054	3.30	6.50
ASCII keyboard	83058	21.60	43.25
JUNE 1983			
Maestro (part 2)	83051-2	16.60	33.25
energy meter	83067	3.60	7.25
spectrum display			
filter board	83071-1	4.20	8.25
control board	83071-2	4.10	8.25
display board	83071-3	4.00	8.00
JULY/AUGUST 1983			
Cresthermometer	83410	3.60	7.25
flashing running light	83503	2.40	4.75
μProcessor aid	83515	2.90	5.75
simple D/A converter	83558	2.50	5.00
heat sink temperature indicator	83563	2.10	4.25
SEPTEMBER 1983			
alarm extension			
transmitter board	83069-1	3.50	7.00
receiver board	83069-2	3.40	6.75
VDU card	83082	13.40	26.75
personal FM	83087	3.00	6.00
OCTOBER 1983			
basicode interface for the Junior Computer	83101-2	2.00	4.00
cosmetics for FSK signals	83106	3.60	7.25
simple anemometer			
memory board	83103-1*	4.80	9.50
measuring board	83103-2*	2.00	4.00
NOVEMBER 1983			
bus board	80024	7.70	15.50
electronic metronome	83107-1*	3.60	7.25
	83107-2*	2.10	4.25
CPU card	83108-1	9.20	18.50
	83108-2	5.70	11.50
speed controller for model railway	83110	4.30	8.50
DECEMBER 1983			
64-way bus extender board	83102	10.60	21.25
disco phaser	83120-1*	5.60	11.25
	83120-2*	3.50	7.00
symmetrical power supply	83121	4.80	9.50
frost warner	83123	2.50	5.00
JANUARY 1984			
audio embellisher	83133-1	3.10	6.25
	83133-2*	4.40	8.75
	83133-3	3.70	7.50
digital cassette recorder	83134	5.50	11.00
wind direction indicator	84001	6.70	13.50
how accurate is your watch	84005-1	4.60	9.25
	84005-2	4.40	8.75
FEBRUARY 1984			
video sync box	83124	2.80	5.50
programmable disco light display	84007-1	10.30	20.50
	84007-2	3.90	7.75
rev counter for diesels	84009	2.00	4.00
capacitance meter	84012-1	5.30	10.50
	84012-2	3.10	6.25
video combiner	84018	2.70	5.50
MARCH 1984			
triac control board	84019	6.10	12.25
Elabyrinth	84023-1	5.00	10.00
	84023-2	4.40	8.75
real-time analyser	84024-1	5.05	10.00
	84024-2	4.30	8.50
UHF video modulator	84029	3.40	6.75
APRIL 1984			
intelligent EPROM eraser	84017	5.30	10.50
real-time analyser	84024-3	15.50	31.00
	84024-4	21.60	43.25
variable a.c. power supply	84035	2.90	5.75
pulse generator	84037-1*	6.40	12.75
	84037-2*	7.70	15.50
MAY 1984			
real-time analyser	84024-5	4.80	9.50
video display	84024-6	8.00	16.00
short wave pocket radio	84040*	6.30	12.50
mini crescendo	84041	6.50	13.00
switching power supply	84049	4.00	8.00
JUNE 1984			
portable distress signal	84048	3.30	6.50
ZX extensions	84054	3.85	8.00
daisywheel typewriter printer interface	84055	5.15	10.50
echo sounder	81105-1*	5.00	10.00
	84062*	5.95	12.00
FM wireless microphone			
transmitter	84063	3.85	7.75
receiver	83087	3.00	6.00
JULY/AUGUST 1984			
microcomputer power supply protection	84408	2.45	5.00
economical motor drive	84427	2.55	5.00
fridge alarm	84437	2.55	5.00
VHF/AM air-band converter	84438	3.75	7.50
RS 232 analyser	84452	3.45	7.00
musical doorbell	84457	3.05	6.00
frequency meter	84462	5.50	11.00
μP power supply	84477	5.95	12.00
SEPTEMBER 1984			
electronic cross-over filter	84071	5.95	12.00
SCART adapter	84072	3.55	7.00
lamp saver	84073	2.55	5.00
	84083	2.40	4.75
digital tachometer	84079-1	3.40	7.00
	84079-2	4.60	9.25
flash counter	84081	4.35	8.75
direct-coupled modem design	84031	17.85	35.75
ZX81 pulse cleaner	84075	4.50	9.00
RS232 centronix adapter	84078	6.60	12.25
video inverter	84084	4.05	8.00
OCTOBER 1984			
ZX81 pulse cleaner	84075	4.50	9.00
RS232 centronix adapter	84078	6.60	12.25
video inverter	84084	4.05	8.00
NOVEMBER 1984			
burglar alarm	84088	2.70	5.50
autodim	84096	2.65	5.25
telephase	84100	2.50	5.00
TV as monitor	84101	2.70	5.50
mini printer	84106	7.45	15.00
DECEMBER 1984			
time switch	84107	2.75	5.50
function generator	84111	8.15	16.25
give your soldering tip a longer life	84112	2.60	5.25
computer-controlled slide fader	84115-1	11.30	22.50
	84115-2	6.95	14.00
slot-car controller	84130	3.90	7.75
JANUARY 1985			
rumble detector	84109	3.15	6.25
portable guitar amplifier	84128	5.60	11.25
30 watt output stage	85001	3.50	7.00
VHF/UHF modulator	85002	2.50	5.00
Commodore cassette interface	85010	2.90	5.75
μP-controlled frequency meter			
main board	85013	11.55	23.00
display board	85014	4.70	9.50
crystal oscillator	85015	2.40	4.75
FEBRUARY 1985			
RLC meter	84102	7.15	14.25
input stage for the frequency counter	85006	4.65	9.25
EPROM switchboard	85007	3.45	7.00
symmetrical microphone amplifier	85009	2.85	5.75
MARCH 1985			
versatile up/down counter	85019	3.15	6.25
darkness-sensitive light switch	85021	2.80	5.25
pH meter	85024	4.85	9.75
KITT scanner	85025	3.95	8.00
AXL amplifier	85027	7.10	14.25

Back numbers of *Elektor Electronics*

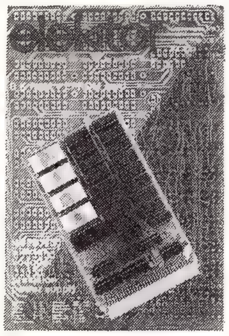
E34, February 1978
Infra-red Light Gate/Throwing Some Light on LEDs/Formant – the Elektor Music Synthesiser (c)/Slow on/off/CMOS Function Generator/Zener/Tester/Development timer/Experimenting with the SC/MP (4).

E38, June 1978
¼ GHz Counter/Constant Amplitude Squarewave to Sawtooth Converter / Servo Polarity changer / Monopoly Dice / Mini Counter / Digital clock Using the SC/MP/Programmable Call Generator / TV Sound Modulator/Automatic Stereo Switch/Traffic Light controller.Easy Music.

E54, October 1979
Touch Tuning/Battery Saver/Impedance Bridge/New Programs for the SC/MP/Digital Rev Counter/Digifarad/Short-interval Light Switch/PCB for Variable Fuzz Box/Gate-dipper/Strain Gauge/I Played TV Games/Programmable Sequencer.

E55, November 1979
Topamps/Flash Sequencer/Electronics the Easiest Way/Remote control Motor Switch/Home Trainer/fuel Economiser/I Played TV Games (2)/Shortwave converter/Ionosphere/Low Voltage Dimmer/I See your Point/Servo-controlled Motor.

E58, February 1980
Aerial Booster/Fet Opamps in the Formant / TV Interference Suppression / Elektor Vocoder (2)/Aerial Amplifiers / Digisplay/Analogue Delay Technology / Extending the ¼ GHz Counter/Digital Thermometer.



E65, September 1980
8K RAM + 4.8 or 16K EPROM on a Single Card/Precision Power Unit/Electronic Linear Thermometer/The Josephson Computer/VOX Printed Circuit Board/Ejektor: Measuring Multipath/High Speed Readout for Elekterminal/Musical Box/Electrolytology/Curve Tracer/Using the Vocoder.

E66, October 1980
Programmable Slide Fader/Touch Doorbell/Switched Capacitors/More TV Games/The Junior Computer Memory Card/Remote Control Slide Projector/Video Pattern Generator/LCD Tuning Scale/Dual Slide Faders.

E67, November 1980
An r.p.m. Indicator as an Economy Guide/Draught Detector/How to Recycle Dry Cell Batteries/Energy Saving Know-how/Simple fuel Economy Meter/Automatic Pump Control/Long Life Technique in Light Bulbs/Automatic Curtain Control/Fridge Alarm/Know the ins and outs of your Central Heating system/Energy Saving Motor Control/Coffee Machine Switch/Operational Hours Counter.

E68, December 1980
Canned Circuits: 23 of the best entries which include Midnight Raid Detector/A 'Flash in the Can'/Canometer/Canine Defence.

E70, February 1981
Audio Power Meter/Noise Reduction/Process Timer/High voltage from 723/Juniors Growing Up/The Voiced/Unvoiced Detector/Emergency Brake for the Power Supply/150 W DC to DC Converter for the Car/Low Noise 2 Metre Pre-Amp/2½ Digit DVM/Wagnephon.

E72, April 1981
Transistor Match-maker/Universal Power Supply/Intelekt/Humidity Sensor/Logic Analyser II/Crystal-controlled Stroboscope/Junior Cookbook.

E73, May 1981
Camping Clock/Frequency Doubler/The Fully Fledged Junior Computer/Talk to Computers/Choke Alarm/Bar Codes/Logic Analyser/Waveform Generator/Sophisticated software for the Junior Computer/Reading Bar Codes.

E77, September 1981
DFM + DVM/Revolution Counter/Digital Barometer/dB Converter/TV Games Extended/Disco Lights Controller/QUAD ESL 63/Analogue LED Display/Volt/Ammeter for Power Supplies/Chattering Chips/Transistor Ignition Update/Soldering Aluminium.

E89, September 1982
Gas Detector/Rapid Loading Games/The Elektor Connection/Inductive Sensor/Darkroom Computer Part 1/Applikator/Home Telephone System/Synthesised Sound Animation/Time Receiver for the Rugby MSF/Three Phase Tester.

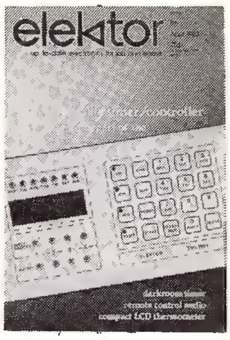
E90, October 1982
DSB Demodulator/L.C.D. Thermometer/Ultra Sonic Distance Measurement/Electrolytics Run Dry/Darkroom Computer Part 2/Short Wave Band Shifting for SSB Receiver/16 Channels with only Five ICs/Pre-amp for the SSB Receiver/Active Aerial/Transistor and IC Data.

E91, November 1982
Drum Interface/Talking Dice/Model Train Lighting/Guitar Tuner/Cerberus/Floppy Disc Interface for the Junior/Cubular Bell/Mini-Organ Extension/Kitchen Timer.

E93, January 1983
Milliohmmeter/accessories for the Crescendo power amplifier/Darkroom computer tips/Chips for digital audio / 3 A computer supply/Traffic-light control system / Tomorrow's music / Upper and lower case on the Elekterminal.

E94, February 1983
Prelude part 1/VAM – video/audio modulator/Main beam dimmer/Prelude class A headphone amplifier/Fuse protector/Acoustic telephone modem/Double dice/Chips for digital audio part 2.

E96, April 1983
Low power digital thermometer/MC/MM phono preamp/Membrane switches/Interlude/RC equalizer / 7-day timer / controller/Junior program tester/Prelude (part 3)/Programmable darkroom timer/Talking clock extension.



E97, May 1983
Wattmeter/ASCII keyboard/Prelude p.s./Multitester/Maestro (part 1)/What is power?/Parallel-serial keyboard converter/Morse converter/78L voltage regulators ...and 79L/Morse decoding with the Z80A.

E99/100, July/August 1983
Summer Circuits Double Issue containing over 100 projects.

E101, September 1983
Video Graphics/Autotest/64k on the 16k Dynamic RAM Card/high-speed CMOS/VDU Card/Personal FM/Precision Voltage Divider/alarm Extension/Junior Synthesizer/Simple MOSFET Test.

E102, October 1983
Basicode-2 / Music Quantisizer/Solid-state Darkroom Lighting/High-voltage Regulator / Anemometer / Programmable Power Supply/Basicode-2 Interface for the Junior Computer/Electronic Voltage Regulator / Battery Eliminator/Transistor Selector/FSKleaner/EPROMmer using the Junior Computer.

E103, November 1983
Doorbell – or telephone – operated flashlight/Power Controller for Model Railways/Decoupling in Digital Circuits/CPU Card/Decimal to Binary Converter/Movement Detector/Electronic two-tone Metronome/Pseudo Stereo/Universal Terminal/Ultrasonic/Infrared Barrier/Trick battery/Crescendo revisited.

E104, December 1983
64-way 2-dimensional Bus Board/MF/HF USB Marine Receiver/LED Ornaments/Symmetrical Power Supply/Video Amplifier/Locomotive Headlamp Reverser/Frost Warning Device/Disco Phaser/Banking Program/NOV-RAM: Data Storage without Batteries/Bus Extension/ + Cumulative index 1983.

105, January 1984
Gyrophone/How accurate is your watch?/Digital Cassette Recorder/Audio Signal Embellisher/Universal Active Filter/from Thermometer to Thermostat/Audio Sleuth at work/Wind Direction Indicator/Z80 EPROM programmer/Home-made low-cost Wiring Probe/Address deding.

E106, February 1984
6502 Tracer/Diesel Tachometer/Programmable Disco Display Lights/Video Combiner/Digitester with a difference/Reversing Buzzer/Memory timing/Mating Logic Families/Capacitance Meter/Basicode 2 for Junior plus VDU Card/Constant Voltage Source/CS Chip Selekt/Video Sync Box.

E107, March 1984
Petrol Saver/Triac Control Board/UHF Video and Audio Modulator/GET & GO/Elabyrinth/Varistor Protection Circuits / Real-Time analyser (part 1)/Applicator/Tape Timer.

E108, April 1984
Optical Memories/Controlling the Floppy-disk Drive Motor/Pulse Generator/Using the Pulse Generator/Intelligent EPROM Eraser/Z80 simulator/Metronome Extension/Real-time analyser, part 2/Variable A.C. Power supply/Idlist/Chip Selekt/Tape Contents Detector.

E109, May 1984
Noise Squelch/Short-wave Pocket Radio/Floppy Tester/Switching Power Supply/Analytical Video Display/Aviary Illumination/How many Watts?/Mini Crescendo/a look at EXOR and EXNOR Gates/EPROM Copier/Digital Cassette Recorder revisited/Real-time Analyser, part 3/RS423 Interface.

E110, June 1984
Portable Distress Signal/ZX Extensions/Disco Drum/Daisywheel Typewriter Printer Interface/Maximum and Minimum Memory/Lead-acid Battery Charger/Wireless Microphone/Merging BASIC Programs/Echo Sounder/Versatile Audio Peak Meter.

E111/E112, July/August 1984
Summer Circuits Double Issue containing over 100 projects.

E113, September 1984
Data Communication by Telephone/Active cross-over Filter/Digital Cassette Recorder with the ZX81/Flash Meter/Digital Tachometer/DIRPUT/SCART Adapter/Anodizing Aluminium / Lamp Saver/Double-sided Printed Circuit Boards

E114, October 1984
The Sinclair QL – first impressions/Basicode-2/Tuning Fork/Balancing Transformers Video colour Inverter/Programming the 6845/ZX81 Cassette Pulse Cleaner/Direct-coupled Modem/
Battery Tester/RS232 centronics Converter/Dynamic Pre-amplifier.

E115, November 1984
The Story of Valves/Autodim Mini Printer/Burglar Deterrent How to make your own PCBs RS232/V24: the Signals/Use you TV Receiver as a Monitor/Tele phase/Valve Amplifier/Electroni Gas Meter.

E117, January 1985
Commodore Cassette Inter face/VHF/UHF Modulator/Port able Guitar Amplifier/30 watt a.f Output Stage/JSR swap/Rumbl Detector/μP-controlled Frequenc Meter/Switching Radio Contr Channels.

E118, February 1985
Gyroflash/1.2 GHz Input Stage Microphone Preamplifier/Remot Model Control by Microcomputer DIY Connector/Programmabl Rhythm Box/EPROM Selec tor/Receiver Power from Engin Battery/RLC Meter/Program mable Keyboard Encoder.

E119, March 1985
K.I.T.T. Scanner/AXL Ampl fier/pH Meter/Turnout (points Control/New Keyboard for Spec trum/19 kHz Precision Cal brator/Versatile Counter Ci cuit/Darkness-sensitive Ligh Switch/Mini Active Lou speaker/Transistor Unitester.

E120, April 1985
Light-powered Radio/Revoluti Counter/X-Y Plotter/The Fir Cuckoo in Spring/Real-time Clo for Micros/10 A Pow Supply/Stepping Motors.

E121, May 1985
A/D and D/A Conversion/Pr grammable Timer/Universal I/ Bus/an IBM Compatible Mic (Intro)/Glow Plug Modulato Digitizer/Programmable Arr Logic/Automonitor/Panorama Mixer.

E122, June 1985
Tone Burst Generator/Infra-r Movement Detector/an IBM Co patible Micro/RAM used EPROM/Service Interval Time Electric Pantograph/Digital Osc lators/The Short Search/A phanumeric Display/ Solar Ba tery/Computer Eye.

E123/124, July/August 1985
Summer Circuits Double Iss Containing over 100 projects.

E125, September 1985
Intruder Alarm/Solid-state Rela PL301 Loudspeaker/High-res ution Colour Graphics Card/Fr quency Standard/Cleaning Vid Recorders/RS232 Interface.

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n, to 220n 15p
n 16p
n 22p
n 24p
n, 560n 27p
n 33p
(10mm) 37p
F (15mm) 75p
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to 100n 8p
n 10p
n 11p
n 15p
n 16p
n 19p
25p
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4034 1 39
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7824T 55p
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7805K 2.33p
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7812K 2.33p
7815K 2.33p
7824K 2.33p
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79L12 49p
79L15 49p
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TIP33A 1 22p
TIP33C 1 35p
TIP34A 1 27p
TIP34C 1 35p
TIP35A 1 87p
TIP35C 2 14p
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BA158 20p
BA159 21p
BA182 31p
BA317 4p
BAV10 10p
BAV20 13p
BAW49 21p
BAX13 8p
BAX16 8p
BB105 65p
BB109 45p
BY126 12p
BY127 13p
BY133 19p
BY399 27p
MR754 (400V 6A) 61p
MR756 (600V 6A) 87p
OA91 16p
OA200 10p
OA202 11p
IN914 4p
1N4001 4p
1N4002 4p
1N4004 5p
1N4007 7p
1N4148 3p
1N5401 13p
1N5404 16p
1N5408 20p
17A 200V 125p
17A 800V 158p
70A 400V 230p
70A 1 2KV 295p

SCR's TRIACS DIACS
THYRISTORS
4 8 & 12 Amps
Texas TO220
Suffix A = 100 V
Suffix B = 200 V
Suffix C - 300 V
Suffix D = 400 V
Suffix M = 600 V
4A
TIC106A 66p
TIC106B 67p
TIC106C 68p
TIC106D 69p
TIC106M 75p
8A
TIC116A 88p
TIC116B 89p
TIC116C 93p
TIC116D 97p
TIC116M 99p
12A
TIC126A 86p
TIC126B 90p
TIC126C 91p
TIC126D 92p
TIC126M 1 10p
TRIACS
Texas 400V
TO220 Case
TIC206D (4A) 79p
TIC225D (6A) 88p
TIC226D (8A) 89p
TIC236D (12A) 1 37p
TIC246D (16A) 1 40p
TIC253D (20A) 2 70p
TIC263D (25A) 2 91p
DIACS
BR100, DB3, ST2 29p

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400mW 3V3 to 33V 7p
1 3W 3V3 to 82V 14p
2 5W 7V5 to 75V 75p
5W 3V3 to 33V 80p

BRIDGE
(PIV shown in brackets)
1½ amp type
WO1(100) 28p
WO2(200) 34p
WO4(400) 33p
2 amp type
Square
with hole
SO1(100) 46p
SO2(200) 50p
SO4(400) 55p
6 amp
Square
with hole
PW01(100) 95p
PW02(200) 99p
PW04(400) 1 30p
PW06(600) 1 39p
25 amp type
Metal clad
with hole
KO1(100) 2 62p
KO2(200) 2 75p
KO4(400) 3 25p
KO6(600) 4 10p
BYW64 35A
400W 3 86p

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Large diffused
1 +
R5D 10p
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Y5D 16p
Small diffused
R3D 10p
G3D 16p
Y3D 16p
Micro 0.1"
RIM 21p
GIM 23p
YIM 23p
Large clear
R5C 14p
G5C 19p
Y5C 19p
Super bright high efficiency Large (100 times brighter)
R5U 53p
G5U 53p
Y5U 53p
Rectangular Stackable LEDS
R5R 21p
G5R 23p
Y5R 25p

LIN ICs
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AY38910 3 99p
AY38912 4 95p
CA3046 69p
CA3048 5 54p
CA3059 3 33p
CA3080E 69p
CA3130E 79p
CA3130T 2 22p
CA3140E 45p
CA3140T 1 67p
CA3240E 1 39p
HA1366W 1 99p
HA1388 3 96p
HA1389 2 96p
HA1389R 2 96p
HA1392 3 69p
HA1397 4 89p
ICL7106 7 51p
ICL7107 9 37p
ICL7611 85p
ICL8038 3 40p
ICM7555 69p
ICM7556 1 49p
L200C 1 99p
LA4201 1 99p
LA4400 1 99p
LA4420 1 36p
LA4422 1 93p
LA4430 1 94p
LA4440 2 98p
LA4460 2 98p
LA4461 2 98p
LF347 1 69p
LF351 39p
LF353 65p
LF355 1 15p
LF356 1 09p
LF357 1 63p
LF398 5 50p
LM10CH 6 99p
LM11CH 10 95p
LM301AN 36p
LM304H 4 34p
LM307N 74p
LM308N 69p
LM309K 2 09p
LM310N 3 33p
LM311N 69p
LM317K 3 57p
LM317T 1 45p
LM317HVK 10 80p
LM324 49p
LM334Z 1 39p
LM335Z 1 47p
LM336Z 1 30p
LM337K 6 58p
LM337T 1 36p
LM339N 45p
LM348N 84p
LM349N 1 73p
LM350K 5 99p
LM360N 6 24p
LM361N 3 63p
LM380N141 19p
LM380N8 1 39p
LM381AN 1 75p
LM382N 1 93p
LM383T 2 76p
LM384N 2 75p
LM386N 97p
LM387N 1 89p
LM388N 1 60p
LM391N601 55p
LM391N801 75p
LM396K 22 34p
LM723CH 1 25p
LM723CN 69p
LM725CN 5 93p
LM741CH 1 05p
LM741CN 28p
LM741CN14 1 20p
LM747CN 57p
LM748CN 62p
LM1035N 5 36p
LM1037N 3 62p
LM1458N 44p
LM1496N 1 67p
LM1886 5 58p
LM1889 2 99p
LM2902 1 22p
LM2907N 2 66p
LM2907N82 66p
LM2917N 2 66p
LM2917N82 66p
LM3301 1 16p
LM3524 2 95p
LM3900 69p
LM3911 2 09p
LM3914 2 99p
LM3915 2 99p
LM4250 2 89p
LM13600 1 64p
LM13700 1 64p
MC1466L11 99p
MC1468L 8 50p
MC1488 99p
MC1489 99p
MC3340 2 66p
MC3357 2 11p
MC3446 3 95p
MC3447 5 50p
MC3470 6 95p
MC4024 6 60p
MC4044 6 60p
MF10 4 18p
NE529 2 25p
NE531N 1 99p
NE543N 2 75p
NE544N 2 31p
NE555 28p
NE556 69p
NE558 1 89p
NE560 3 25p
NE565 1 06p
NE566 95p
NE567 1 95p
NE570 3 14p
NE571N 1 98p
NE5532AN 1 55p
NE5534A 1 49p
RC4194 2 60p
RC4195 2 06p
RC4558 63p
RC4739 1 08p
SN76477 7 95p
SN76003 3 50p
SN76013 3 50p
SN76023 3 50p
SN76033 3 50p
TA7204 1 19p
TA7205 1 15p
TA7222 1 75p
TA7227 2 85p
TBA500 3 99p
TBA510 3 25p
TBA520 2 99p
TBA530 2 99p
TBA540 3 25p
TBA550 3 25p
TBA560C 2 99p
TBA570 2 75p
TDA1002 4 35p
TDA1003 4 35p
TDA1010A 1 95p
TDA1011 2 50p
TDA1022 3 75p
TDA1024 1 12p
TDA1151 1 95p
TDA1170S 3 10p
TDA2002 1 95p
TDA2003 1 95p
TDA2004 2 48p
TDA2020 2 75p
TDA2030 1 99p
TDA2611 1 59p
TDA4600 2 79p
TDA7000 2 49p
TEA1002 3 95p
TL061 62p
TL062 99p
TL064 1 25p
TL071 39p
TL072 56p
TL074 1 09p
TL081 39p
TL082 56p
TL084 99p
TL494 420p
TL497 2 69p
UA739 3 36p
UA759 3 77p
UAA170 2 49p
UAA180 2 49p
ULN2001 1 54p
ULN2002 1 54p
ULN2003 1 15p
ULN2004 1 15p
UPC575C2 1 19p
UPC1156H 1 75p
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2 × 20V 4 30
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75 × 100mm 69p
100 × 100mm 79p
150 × 100mm 129p
160 × 100mm 135p
200 × 100mm 159p
500 × 100mm 389p
VQ Board 225p
Track cutter 165p
Pin inserter 239p
100 pins s sided 65p
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Quick dissolving
Enough to make over 1 litre 1 75p
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1 Thin lines
2 Thick lines
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4 Thick bends
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7 Dots & holes
8 0 1" edge connectors
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Any sheet of above 39p
GRADE ONE GLASS PCB SINGLE SIDED
178 × 240mm 1 85p
420 × 195mm 2 55p
420 × 245mm 3 75p
DALO ETCH RESIST PEN + spare nib 1.29p
PHOTO SENSITIVE PCB
1st Class Epoxy Glass for better results than spraying expose to UV
Single sided
100 × 160 2 25p
100 × 220 2 65p
203 × 114 2 55p
233 × 220 5 75p
Double sided
100 × 160 2 35p
100 × 200 2 95p
203 × 114 3 05p
233 × 220 6 45p
Developer for above (do not use Sodium Hydroxide)
500ml 3 19p

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Solid connecting wire
MAINS SPEAKER
Twin 1 Amp 16p
Twin 2½ Amp 19p
3 Core 2½ Amp 21p
3 Core 13 Amp 62p
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Stereo 29p
Mini Single 13p
Mini Stereo 16p
4 Core
4 Screens 49p
4 Core Single Screen 62p
8 Core 73p
12 Core 88p
Heavy Duty Mike Guitar Lead 33p
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50Ω RG58A 29p
75Ω UHF 31p
75Ω VHF 31p
300Ω Flat 16p
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16way 39p
20way 48p
24way 62p
30way 75p
34way 82p
40way 88p
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SOLDER
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Iron stand 210p
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Male 110p
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CENTRONICS 36W
IDC Plug 495p
IDC Socket 495p
Solder plug 375p
IC SOCKETS L PROFILE
6 pin 50p
8 pin 8p
14 pin 9p
16 pin 10p
18 pin 16p
20 pin 20p
24 pin 24p
28 pin 28p
40 pin 30p

ZIF SOCKET
24pin 4 35p
28pin 5 00p
40pin 5 35p

SWITCHES
TOGGLE (MIN)
SPST 63p
SPDT 66p
DPDT 79p
DPDT C OFF 99p
4PDT 3.79p

electronics scene

In an age of sophisticated high technology, the power supply that keeps a tiny Scottish island's telephones ringing comes from something as simple and basic as water. The fifteen British Telecom customers who are inhabitants of Rhum, off Scotland's west coast, are served by an exchange whose generator is powered by water from a man-made dam.

Photograph by courtesy of British Telecom.

Pictures by telephone lines help save lives, time, and money

Following successful trials in the south west of England, British Telecom has launched Imtran, a life-saving service for sending X-ray and body-scan pictures hundreds of miles by telephone in seconds, nationwide.

Imtran, short for Image Transfer, enables surgeons when away from their hospitals to examine patients' medical pictures or records seconds after they are available. The service avoids wasted hours while information is sent by courier from a distant hospital, with increasing risk to patients' lives.

Imtran was developed by British Telecom's research laboratories at Martlesham Heath near Ipswich. It consists of a portable transmitter-receiver that is plugged into a standard telephone socket. At the transmitting end, the Imtran unit is connected direct to a body scanner or to a TV camera focused on an X-ray picture or on medical records. The images are recreated at the receiver as high-resolution pictures on a TV monitor screen.

The system works by converting the pictures into audio tones for transmission over the telephone and then turning them back into high-resolution images at the distant end. Each picture takes thirty-two seconds to build up, and the effects of disturbance on the line are minimal. Normal conversation is possible before and after picture transfer. Because Imtran uses normal dial-up telephone lines, it can communicate with similar units anywhere in the world.

Computerizing music notation

Oxford University's recently introduced computer program Oxford Music Processor ⟨OMP⟩ is likely to revolutionize the way in which music notation is prepared for printing. It will enable the music publishing industry and musicians of all kinds, professional or amateur, to provide themselves easily with music notation to the highest standard.

OMP carries out almost all the tasks which have traditionally required painstaking and slow manual arrangement of music notation on the page. With this program, the computer takes all the various rules of notation design into consideration and arrives at the finished product within a tenth of the time of traditional methods.

According to the inventor of the system, Richard Vendome of the university's Faculty of Music, music can be keyed into the computer very easily. OMP has been successfully used by musicians with no knowledge of computing, and by young children. The program will be published by Oxford University Press in 1986 at around £500 in the form of a case-bound user's guide and reference manual with a suite of programs on floppy discs.

Mole saves British Telecom £10 million a year

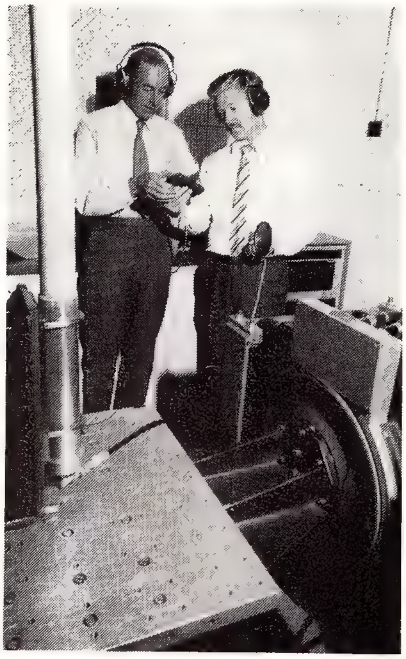
A £100 device that could save about £10 million a year in maintenance costs has won its inventor first prize in British Telecom's New Ideas Competition.

Ernie Huggins, a 59 year old assistant executive engineer, worked for two years in his spare time to conceive the Mole, an electronic locator which can pinpoint faults in underground cables simply and accurately. It reduces the number of holes that have to be dug for each fault from five to two, saving money and reducing disruption to the public.

There are already 3000 Moles in use by British Telecom throughout the UK, and licences are being arranged for its manufacture and sale throughout the world.

Runner-up was Jed Isbell, a 29 year old manager from London, who devised a testing system that will make British Telecom's Packet SwitchStream network even more reliable.

Highly commended were Perry Bebbington and Peter Mosely, both technical officers from Nottingham, for an idea that enhances the compatibility between the Monarch and Herald electronic switchboard systems.



A cellular antenna (left) undergoing vibration testing at Marconi Communication Systems Limited in Chelmsford.

Photograph by courtesy of The Marconi Company Limited.

electronics scene

IT recognition scheme

Ten major employers of staff with information technology ⟨IT⟩ skills are participating in a pilot scheme launched by the British Computer Society ⟨BCS⟩ to improve standards of training on a nationwide basis.

Staff in these organizations, which range from the aerospace, insurance, and computer industries to the Royal and Mechanical Engineers ⟨REME⟩ will take part in the scheme. Successful completion of the scheme would give participants professional status by becoming Members or Fellows of the BCS.

The British Computer Society was founded 28 years ago and has more than 30 000 members. It was granted a Royal Charter in 1984.

Eddystone combats tsetse fly

Eddystone Radio Limited, a division of Marconi Communication Systems Ltd, has received an order from the Crown Agents for sixty Type Orion 5000 HF Transceivers and accessories. The equipment is for use in Zimbabwe by the Tsetse Fly Control Department.

Since its introduction in February this year, the Orion 5000 has been produced in volume and sales, now into twenty-four countries, have exceeded all expectations. As a direct result of this success, two new versions will soon be announced: a trunk-mounted transceiver with remote head unit, and a ruggedized para-military version.

Video for EEC

Oceonics Communications Limited, a subsidiary of the Oceonics Group PLC, have successfully completed the first ever order for the design, supply, and installation of a full motion video conferencing system for the European Economic Commission.

The system links the Berlaymont Building in Brussels with the Robert Schuman Building in Luxembourg. It is intended for the conducting of the community's business between these two important locations by ministers, commissioners, and support and secretarial staff.

Valued at about £250 000, the contract was won against fierce competition from a number of major European systems integrators.

Princess Margaret discusses the Giotto project, in which a space craft built by British Aerospace PLC at Stevenage will intercept Halley's Comet at a distance of 93 million miles from earth in March 1986. The craft will journey through the comet's surrounding coma and tail to within 300 miles of its nucleus. The mass of electronic instruments on board will relay to earth data on, among others, the comet's chemical composition, interaction with the solar wind, and its magnetic field.

(LPS)

British software goes Dutch

Two major Dutch insurance companies, Winterthur BV and Singel Groep Schlencker BV, have chosen computer software from Newcastle-upon-Tyne based Quality Software Products. The total value of the orders amounts to £335 000.

Quality Software Products specializes in application software for mainframe computers. Its OLAS range includes general ledger, sales ledger, purchase ledger, purchase order control, and fixed assets.

A recent example of the United Kingdom's claim to be in the forefront of programmer technology is the PPZ Universal Programmer from Stag Electronic Designs of Welwyn Garden City. The PPZ is capable of programming any device in any technology, such as bipolar PROMs; CMOS, NMOS, and HMOS EPROMs; EEPROMs, PALs; integrated fuses; logic devices; super PALs; and microprocessors.

(LPS)

electronics scene

The Plessey PRS2282A HF Receiver with an FSK converter (for teleprinter use) and a visual display unit, which form part of the present contract.

Plessey radio systems for China

Plessey Radio Systems of West Leigh, Havant, has secured a contract worth £500 000 to supply the People's Republic of China with remotely controlled modular HF Receiving Systems. The equipment will be used to monitor international news broadcasts.

The deal was signed after extensive technical evaluation and working field trials in China. Great emphasis was placed on the performance, reliability, and ease of maintenance.

This order follows close on the heels of another contract won by Plessey from the People's Republic of China for 960 MHz radio and multiplex equipment.

First British-made cellular equipment goes into service

The first cellular telephone equipment made in the United Kingdom is now in use on the Vodafone network as the company enters full-scale production of transportable Vodafones and key base station systems. This marks a major achievement for Racal as the first company to integrate British-made equipment into the country's growing cellular telephone service.

Production of transportable Vodafones is underway at Racal Seaton Limited in Devon — the first UK factory to win BABT (British Approval Board for Telecommunications) approval to manufacture cellular subscriber equipment. The Vodafones are being made under licence from Mobira in Finland and are delivered to Racal-Vodac Limited, the largest supplier of cellular telephones in the UK.

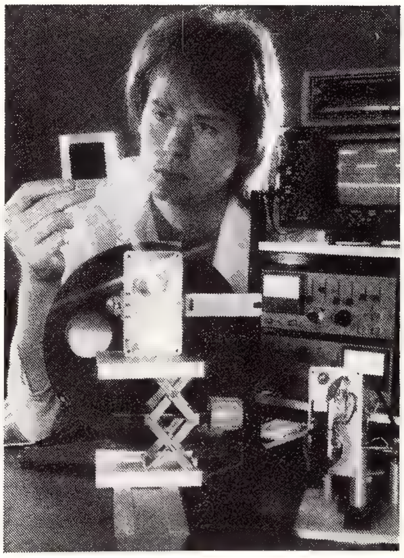
Base station equipment, including important transmitter power amplifiers and sophisticated voice channel sub systems, is assembled at Racal Carlton Limited in Nottinghamshire.

Drawing tomorrow's technology

A researcher at Durham University takes the first steps towards the development of a thermal imaging device that will operate at room temperature without the present need of liquid nitrogen as a coolant. This will lead to a smaller hand-held camera that can be used to find people trapped in buildings or under water by detecting the heat emitted by their bodies.

The development is possible thanks to an updated version of the Langmuir Trough, which can produce alternate layers (superlattices) of different molecules that can be engineered for many purposes with different layers being stacked together for tailor-made functions.

The technique involves drawing a chosen material through the trough which is filled with a liquid. As the material is drawn backwards and forwards, the molecular structure is slowly built up and the resulting film can be used for a variety of applications such as infra-red imaging, optoelectronics, and sensors.



Such films have already been used in the design of a super fast switch operating in nano-seconds. Light emitting diodes can be improved by a factor of more than twelve; solar cell efficiency can be improved by 50 per cent. They can withstand temperatures up to 400 °C, stick like leeches, and are not affected by light.

(LPS)

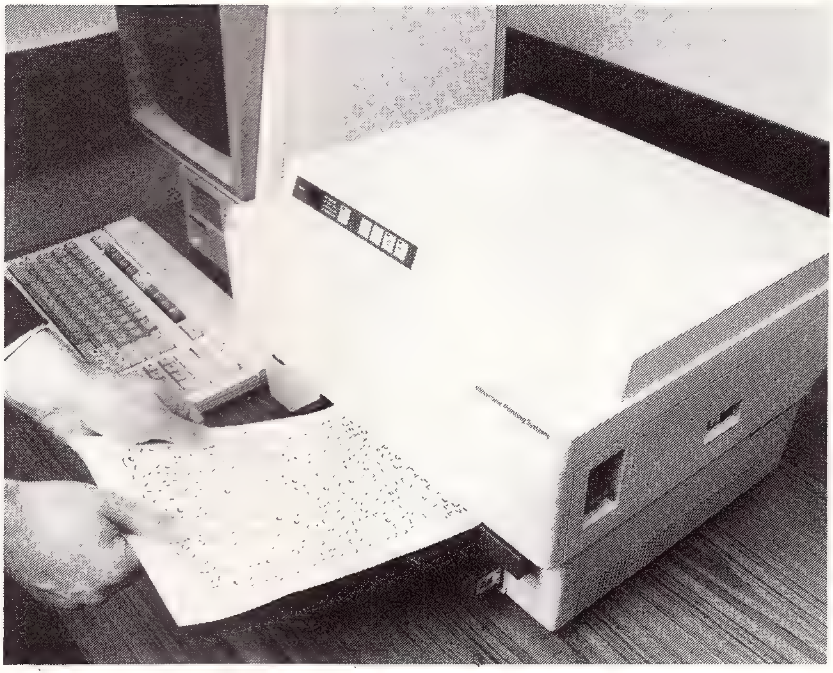
electronics scene

No blunderer this BUMBLE

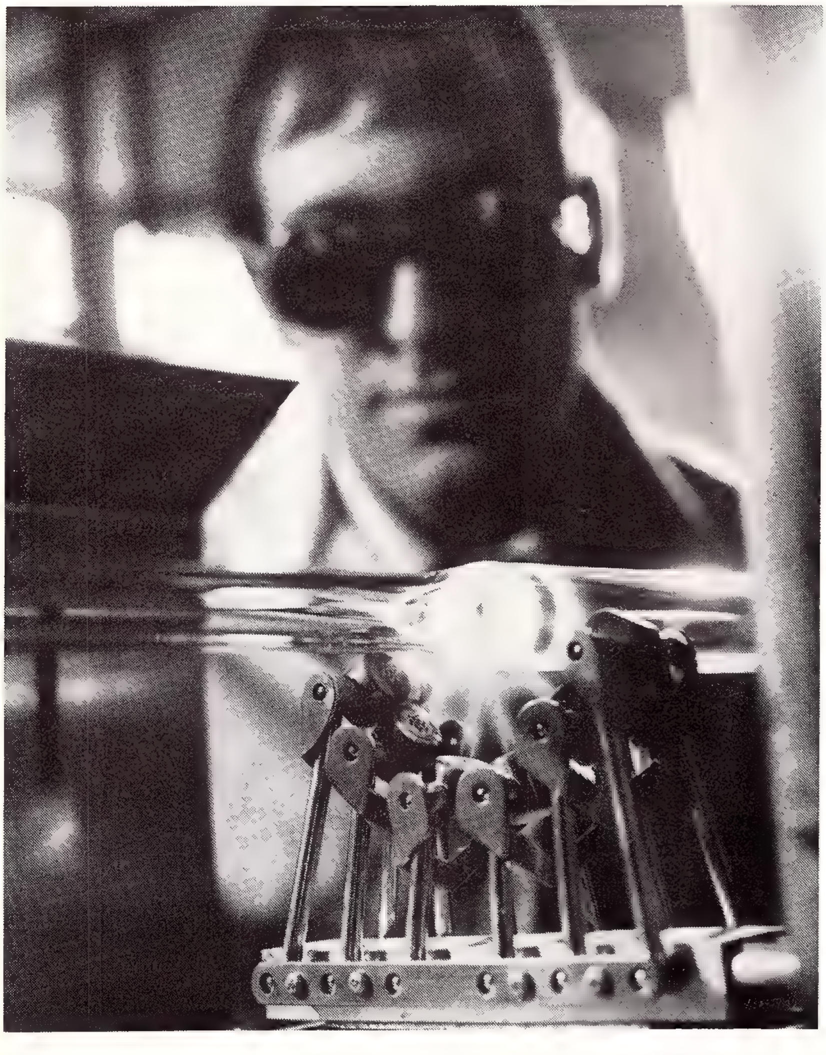
Blind or partially sighted people are severly restricted in their access to information, partly owing to the problems of converting the written word into suitable media for them to read. Now, a word processing system developed by Dr John Gill of the Research Unit for the Blind at Brunel University, goes a long way to improve this position by enabling an ordinary typist to produce documents in Moon, Braille, or large print.

Called BUMBLE, acronym for Brunel University Moon, Braille, and Large-print Equipment, the system features a 16-bit microcomputer, special software, and an EPS laser printer that utilizes the latest developments in printing technology to cope with the variety of founts required.

As it is a non-impact method of printing, laser technology provides the flexibility and high quality to print a large range of type faces, styles, and sizes, which facilitates the high-speed conversion of ordinary written matter to either larger print or to special characters such as Moon.



It is believed that this new system could see the re-emergence of Moon, an embossed language for the blind, which, until now, could only be produced by slow, traditional typesetting techniques. Invented by Dr William Moon of Brighton in 1847 (the language is older than Braille), Moon has a particular advantage in that it is easy to learn, and is especially useful for older blind persons who often find it impossible to master Braille.



British Telecom Research Laboratories' work on optical fibres won the Queen's Award for Technological Achievement earlier this year. Telecom's optical fibres are produced in its research laboratories at Martlesham Heath in Suffolk. By passing the chemical ingredients through a vacuum in the hollow of a super-heated tube of silica, thin layers of the purest optical glass are gradually built up.

Dramatic rise in Telford Industrial Investment

Telford Development Corporation's 1978 decision to cast its industrial recruiting net far beyond the restricted pool of the West Midlands has proved a marked success. There has been a dramatic increase in investment from overseas in the East Shropshire town: from twenty foreign companies with bases in the town in 1978, the figure has grown to over fifty.

Apart from maintaining its industrial recruitment efforts in Britain, the USA, West Germany, and Japan, the Corporation is planning to extend its activities into France.

It appears from a variety of sources that France offers a great deal of potential for inward investment into the United Kingdom. The French government is encouraging companies to look for improved marketing opportunities overseas, particularly in the UK, which, up to now, has not been regarded as one of the traditional market places for French-made products.

electronics scene

DSc for Dutch scientist

Dr Ronald Koningsveld, Director of Basic Research at the Dutch States Mines Company (DSM), Geleen, received an honorary DSc degree from the University of Bristol last July.

An outstanding scientist, Dr Koningsveld is also a leading industrial executive of DSM. He maintains an active association with the University of Bristol and is leading a research team at Antwerp University.

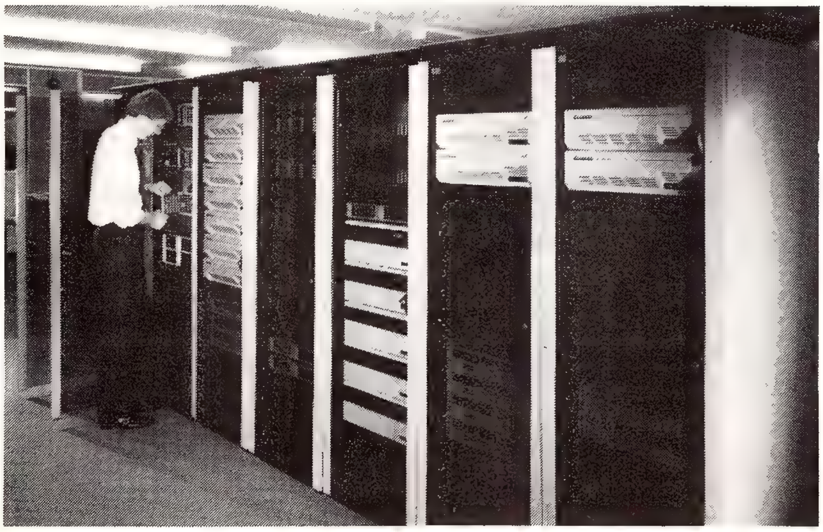
DSM's association with Bristol University started with Dr P Lemstra, an Honorary Research Associate of Bristol University, who now works at DSM. Dr Lemstra worked in the Physics Department of the university on the development of polymer gels leading to the production of a new commercial polyethlene fibre with immense strength, now manufactured by DSM.

(LPS)

Racal for Natwest

Racal-Milgo Limited was recently awarded their largest ever contract by the National Westminster Bank PLC. The order, which is valued at about £18 million, is for communications and network management equipment, system integration, and project management services for the second phase of the Natwest's Digital Integration Network (DIN) project.

The data network will enable the connection of some two thousand branches and departments to National Westminster's computer centres. The network will be linked to equipment sited in branches and departments that will support devices such as displays, printers, and ATMs. When the project is completed, it is expected that more than 10 000 of these terminals will be linked to the system. The network will be the largest integrated data and voice communications network of its kind in Europe.



People

British Aerospace announces that Mr Peter Brighton, the present managing director of Cossor Electronics Limited, is joining the company on 1 October 1985 to succeed Mr D S Barnes as Managing Director of the Electronic Systems and Equipment Division early in 1986.

Brian Lloyd, formerly Chief Executive of Ansafone, has been appointed Managing Director of Thorn EMI Micrologic Limited, the leading UK electronic point-of-sale systems company.

Cambridge Electronic Industries PLC announce the following appointments.

Mr Barrie Cropper as Managing Director of their subsidiary company C.I. (Polymers) Limited.

Dr George D Bartholomew as Director and General Manager of Graseby Medical Limited.

Mr Jim Beardall as Director and General Manager of PED Capacitors Limited.

Dr John Forrest, who until earlier this year held the Chair of Electronic Engineering at University College, London, and is now the technical director of Marconi Defence Systems Limited at Stanmore, Middlesex, has been elected a Fellow of Britain's top professional engineering body, the Fellowship of Engineering. The Fellowship was formed in 1976 to represent engineers at the highest level and, through its inter-disciplinary character, to promote the science, art, and practice of engineering to the benefit of the public. This is accomplished through liaison with governmental organizations, seats of learning, and with other professional bodies at home and overseas. As well as frequent meetings, lectures, and exhibitions, the Fellowship maintains regular contact with schools, and administers a number of engineering awards. Up to sixty engineers of exceptional merit and distinction are elected to the Fellowship by annual ballot. The total number of Fellows is limited to 1000 at any one time.

Events

Electronic Financial Services (Conference)
Hotel Inter-Continental
London
21 & 22 October 1985

Electric Indonesia (Exhibition)
Jakarta
Indonesia
29 Oct. . .2 Nov 1985

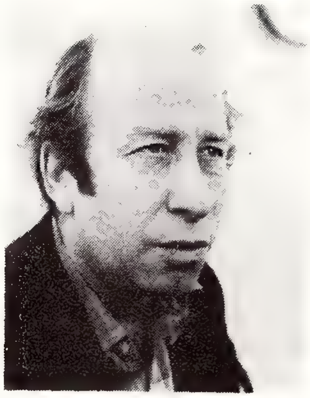
Composants Electroniques 85
(Exhibition)
Exhibition Grounds
Paris
4. . .8 November 1985

Distributed Processing Systems: Technology & Design (Seminar)
The London Tara Hotel
Kensington, London
18 & 19 November 1985

Data Base Management Systems for Micros (Seminar)
Cumberland Hotel
London
21 & 22 November 1985

Obituary

We regret to announce the death on 28 July 1985 of Bob van der Horst, founder and former chief editor of Elektuur BV.



Bob started the company 25 years ago and was its chief editor for twenty years. During his editorship, the original Dutch magazine grew into an international publication that is now printed in ten languages and is read all over the world.

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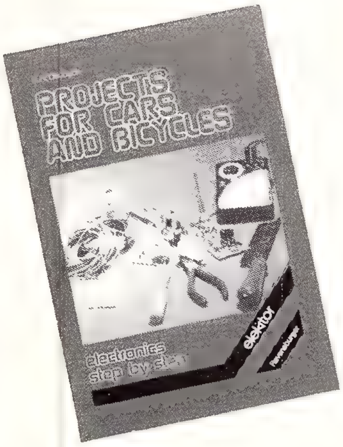

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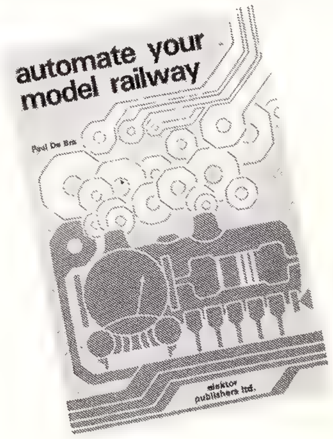


hand-held anemometer

by M Huch

Anemometers are in steady demand by yachtsmen, wind surfers, glider pilots, and amateur meteorologists, to name but a few. The digital anemometer presented here can be built for about half the price of commercially available mechanical versions.

An anemometer is a device for measuring the velocity of, among others, air movement, i.e., wind. Its transducer (also called sensor), i.e., the device that converts the wind speed into electrical signals, is usually driven by a small windmill, or a set of cups. The latter is used in the present design — Fig. 8.

The sensor, at the left in Fig. 1, generates sixteen pulses for every rotation of the set of cups. These pulses, taken over a time determined by the control, are added in a counter. At the end of each counting period, the counter reading is applied to an EPROM; the output data of the EPROM are stored in a display driver. For every counter position, the EPROM has a code in two successive bytes, which determines what will be shown on the LCD display. Via switch S_2, four ranges of the EPROM can be selected over two free address lines, so that the counter reading may be displayed in four different units: metres per second, m/s; knots; kilometres per hour, km/h, and the Beaufort scale. The conversion between these units is, therefore, not carried out direct by the unit, but rather by the programming of the EPROM.

As the anemometer is battery powered, CMOS ICs are used to ensure a low current drain, while the EPROM is only switched on briefly at the end of a counting period to codify the counter reading.

Circuit description

Counters IC_1 and IC_2 in Fig. 2 control the operation of the circuit. A 4.433 MHz (television) crystal can be connected direct to the oscillator input of IC_1.

AND gates N_1 and N_3 generate the pulses required by the sensor. These pulses have a duty factor of 1:64.

1

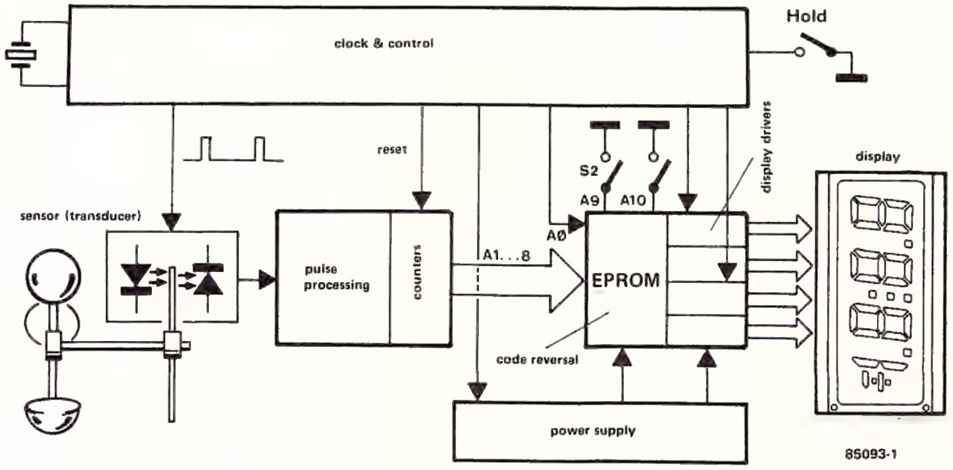


Fig. 1 Block schematic of the anemometer.

2a

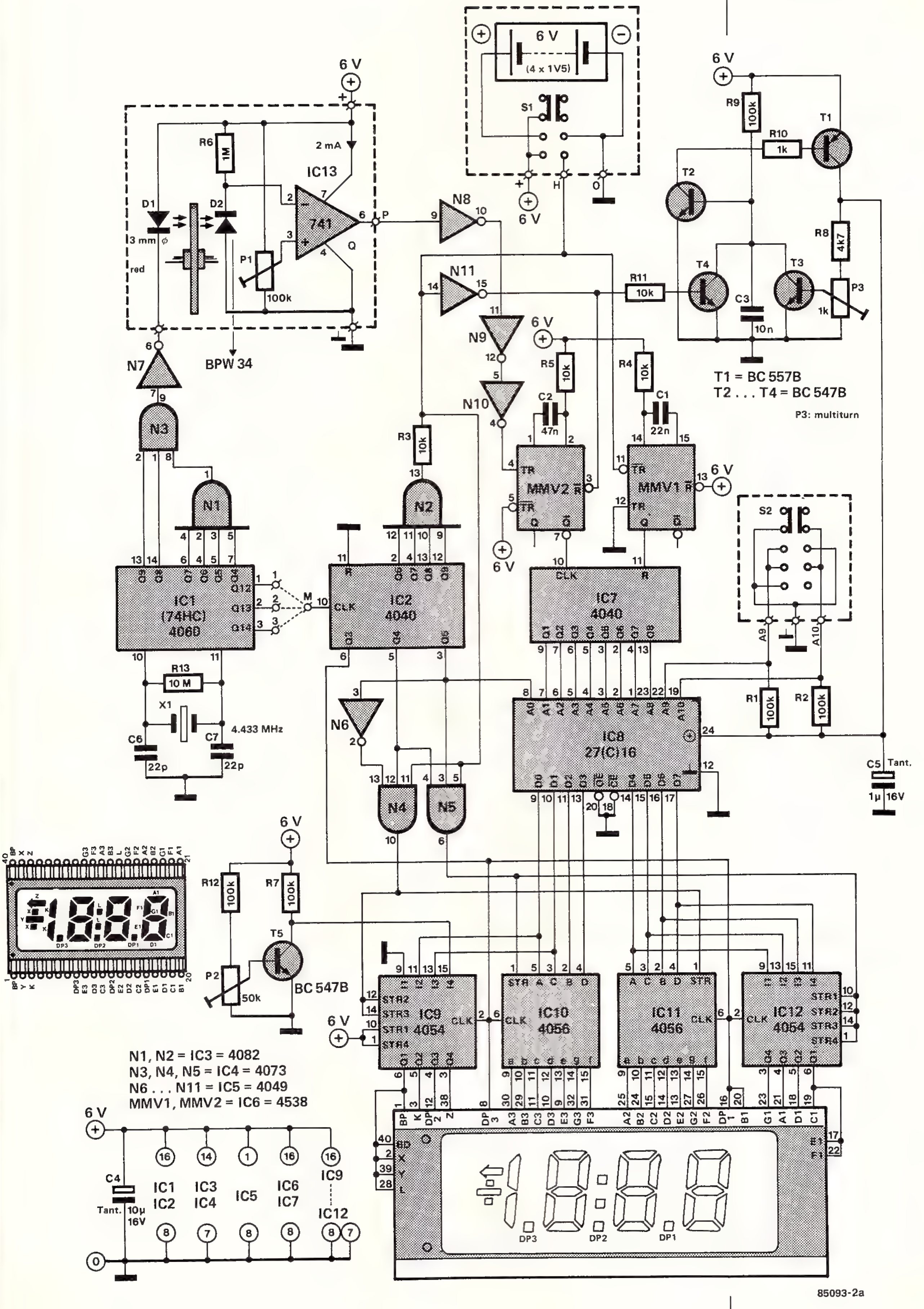


Fig. 2 (a) Circuit diagram of the anemometer.

3

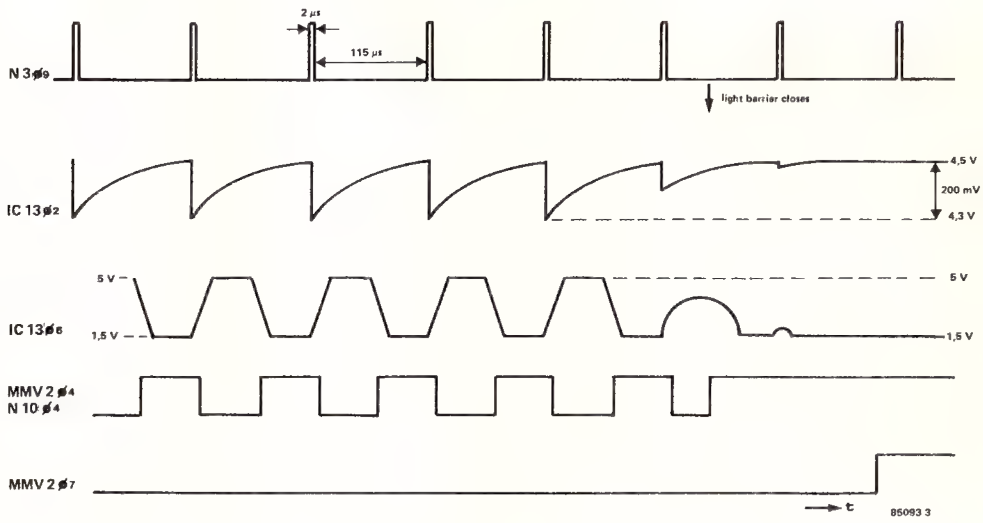


Fig. 3 Timing diagram of the sensor.

2b

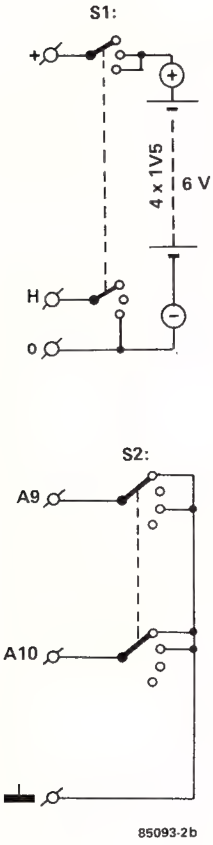


Fig. 2 (b) Diagram for use when rotary instead of slide switches are used in the S_1 and S_2 positions.

The LED in the sensor is driven direct by inverter N_7; a limiting resistor is not required. When the light barrier is open, trapezium-shaped pulses as shown in Fig. 3 appear at the output of the sensor. These pulses are reshaped into rectangular form by inverters $N_8 \ldots N_{10}$. The resulting pulses are stretched by monostable MMV_2 in such a way that they become one pulse, whose period is equal to the time the light barrier is open. These pulses (sixteen per revolution) are counted in IC_7.

The measurement period is controlled by counter IC_2; the relevant timing diagram is shown in Fig. 4. The duration of a measurement may be set to ½ s, 1 s, or 2 s with link M. This enables the processing circuits to be matched to the transducer. As long as the output of AND gate N_2 is logic low, the signals provided by the sensor are processed and counted. When the output goes high, counting stops, the supply to the EPROM is switched on, and pin A_0 of the EPROM is made logic 0. Gate N_4 then generates a pulse which stores the contents of the memory addressed by the counter in the display driver in such a way that bits 0...3 go to IC_9 and bits 4...7 to IC_{11}. Pin A_0 of the EPROM then goes high, and the resulting pulse from N_5 writes bits 0...3 and 4...7 into IC_{10} and IC_{12} respectively. The supply to the EPROM is then switched off, the counter is reset by MMV_1, and a new counting period starts.

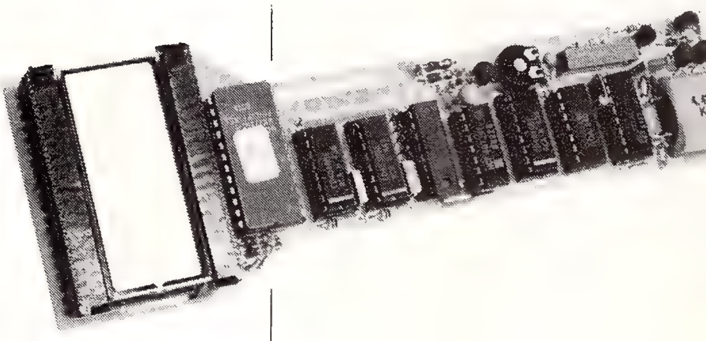
With switch S_1 closed, new counts are not loaded into the display. The previous information remains, therefore, displayed until the switch is opened. In this way, the EPROM programming can determine which units are to be displayed.

The display

The readings appear on a 3½ digit liquid-crystal display (LCD), which also shows LO BAT when the battery voltage is getting low.

This type of display must be controlled with alternating current, since DC control causes damage by electrolysis. Special drivers are, therefore, used to provide an AC control signal. Every other output pulse of the four-bit latches in IC_9 and IC_{11} is inverted by the clocking signal at pin 2 before the output is fed to the display. As the clocking signal is also applied to the backplane of the display, the segments that are in phase with the backplane (latch = 0) remain invisible, while the elements that are out of phase with the backplane (latch = 1) show up black. IC_{10} and IC_{11} operate in an identical manner, but are decoded for a 7-segment display.

The two centre digits of the display are binary coded decimal (BCD). The leading 1, the decimal point after the second digit, and the segments of the last digit can be individually controlled with the



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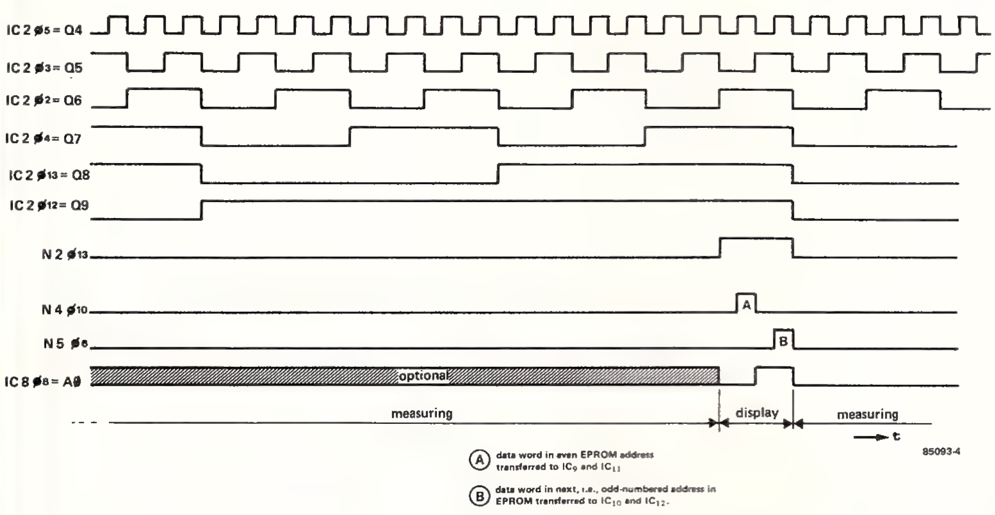


Ⓐ data word in even EPROM address transferred to IC_9 and IC_{11}

Ⓑ data word in next, i.e., odd-numbered address in EPROM transferred to IC_{10} and IC_{12}.

Fig. 4 Timing diagram of the processing circuits.

appropriate bits. This makes it possible for special symbols to be displayed in the last position, e.g., a "b" for Beaufort, and a horizontal stroke for the other units.

The sensor

A thirtytwo-segment disc is rotated across the light barrier by the set of cups that is fitted to the same spindle — see Fig. 5. The thirty-two segments are equally divided into clear and opaque ones. A simple amplifier processes the signals provided by the photodiode.
The LED is driven by 2 μs pulses provided by N_3 (pin 9). The duty factor of these pulses is 2:117 as shown in Fig. 3.
The pulses provided by the light barrier are received by photodiode D_2. Because of the delay in the diode, the signal at the non-inverting input of comparator IC_{13} is sawtooth-shaped. The output of the comparator is a square wave (duty factor 1:1). Preset P_1 should be adjusted so that with the light barrier open the signal at pin 6 of IC_{13} is as clean a square wave as possible.

5

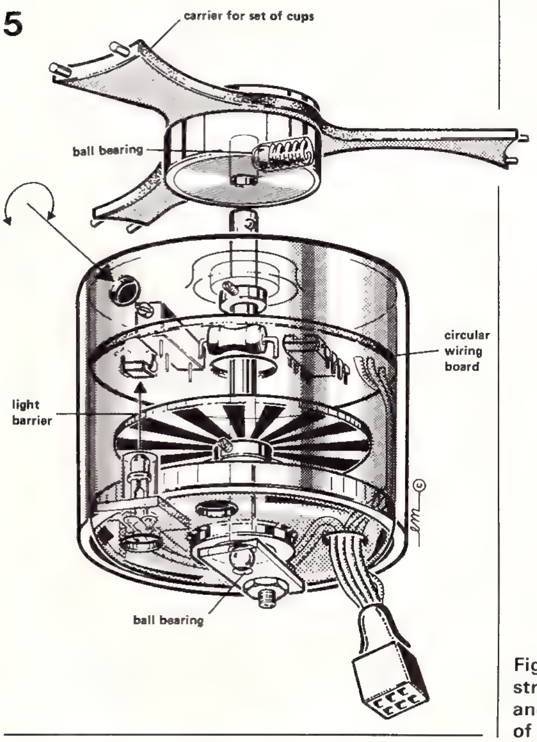


Fig. 5 Suggested construction of the sensor and the carrier for the set of cups (scale = 13:20).

Power supply

The unit is intended for operation from four mercuric oxide button cells, whose e.m.f. ranges from 5 V to 7 V. This is no problem for the CMOS ICs, but does mean that a separate, stable 5.5 V supply is needed for the EPROM. This could, of course, be avoided by the use of a — rather more expensive — CMOS EPROM.
Transistors $T_1 \ldots T_4$ form a voltage limiter, whose output voltage vs battery voltage characteristic is shown in Fig. 6. The limiting threshold can be set with P_3. If the base of T_4 goes high, the supply to the EPROM is switched off.
Transistor T_5 functions as a battery voltage monitor. Preset P_2 is set so that T_5 cuts off as soon as the battery voltage drops below 4.5 V i.e., the level at which the

EPROM begins to work unreliably. When T_5 does not conduct, pin 15 of IC_9 goes high and LO BAT is shown on the display.

Construction

The sensor is most conveniently made from an old cassette recorder motor from which all the innards, except the spindle, have been removed. To make the spindle rotate virtually friction-less, a small ball-bearing is added at the lower end as shown in Fig. 5.

The sensor circuit is built on a circular (vero) board, which must be made to fit exactly in the motor housing. After the board has been wired up, it should be glued firmly in the housing as shown in

6

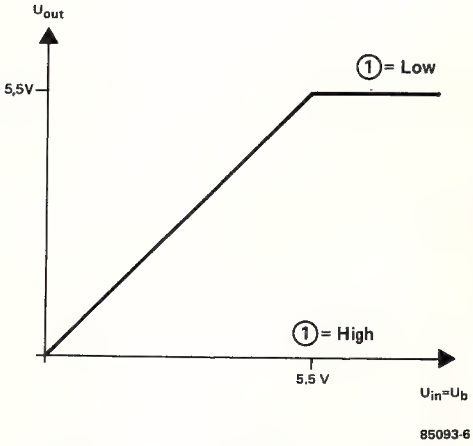


Fig. 6 Limiting characteristic of the supply voltage for EPROM IC_8.

7a b

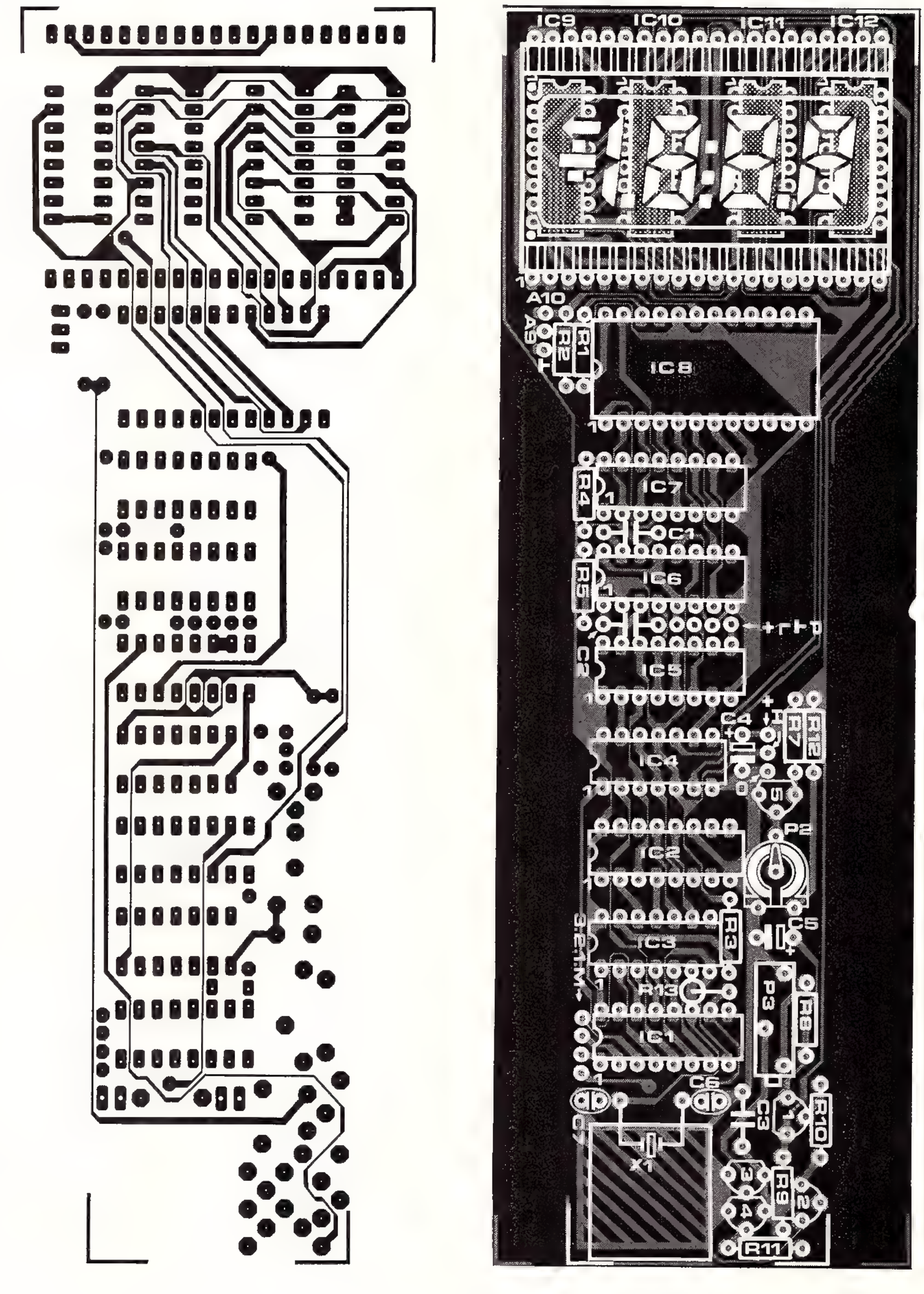


Fig. 7 The double-sided printed-circuit board.

Parts list

Resistors:

$R_1;R_2;R_7;R_9;R_{12}$ = 100 k
$R_3;R_4;R_5;R_{11}$ = 10 k
R_6 = 1 M
R_8 = 4k7
R_{10} = 1 k
R_{13} = 10 M
P_1 = 100 k multiturn preset
P_2 = 50 k preset
P_3 = 1 k multiturn preset

Capacitors:

C_1 = 22 n
C_2 = 47 n
C_3 = 10 n
C_4 = 10 μ; 16 V tantalum
C_5 = 1 μ; 16 V tantalum
$C_6;C_7$ = 22 p

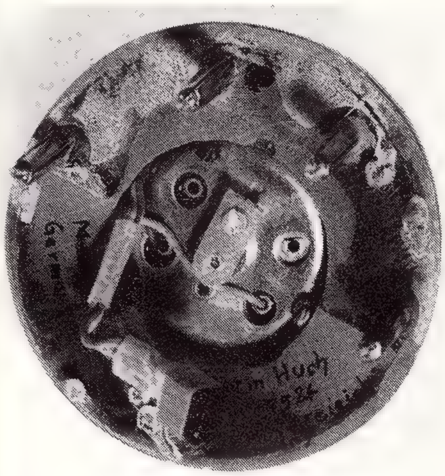
Semiconductors:

D_1 = LED; 3 mm; red
D_2 = BPW34
T_1 = BC 557B
$T_2 \ldots T_5$ = BC547B
IC_1 = 4060 or 74HC4060
$IC_2;IC_7$ = 4040
IC_3 = 4082
IC_4 = 4073
IC_5 = 4049
IC_6 = 4538
IC_8 = 27(C)16
$IC_9;IC_{12}$ = 4054
$IC_{10};IC_{11}$ = 4056
IC_{13} = 741

Miscellaneous:

LCD with LO BAT indication, e.g., Hamlin 3901 or 3902; or Hitachi LS007C-C or H1331C-C
X_1 = crystal 4.433 MHz (television!)
4 button cells, mercuric oxide; 1.5 V each
S_1 = 2-pole; 3-position slide or rotary switch
S_2 = 2-pole; 4-position slide or rotary switch
PCB 85093

Note that IC_{13}; R_6; D_2; and P_1 are not intended for mounting on the PCB.



c

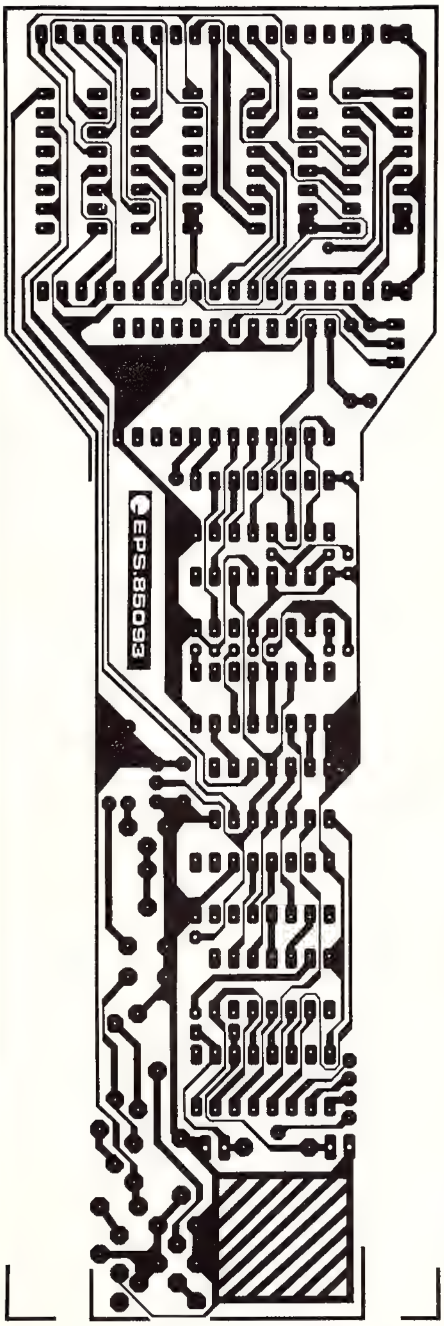


Fig. 5. Make sure that the preset can be adjusted from outside!

The remainder of the sensor is built together as shown in Fig. 5. Make sure that the photodiode and LED are in a straight line. The LED should be prevented from radiating sideways with the aid of some insulating tape or suitable sleeving.

The set of cups is made form three ping-pong balls fastened onto a carrier cut from a sheet of PTFE (Teflon) which itself is glued onto the pulley removed from the cassette motor — see Fig. 5 and Fig. 8. The ping-pong balls are cut in half along their seam, so that a reinforcing rim remains. The resulting half balls are best fitted in place with an epoxy resin.

The printed-circuit board — Fig. 7 — has been designed to fit nicely in a hand-held case.

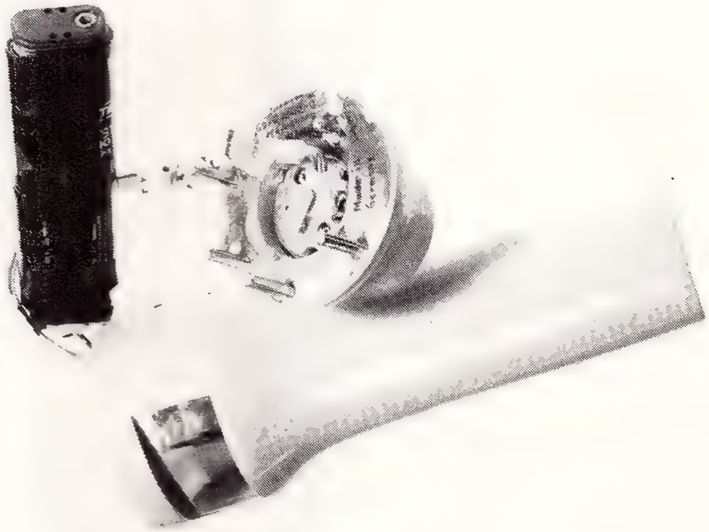
To keep the completed board as flat as possible, it is best to solder the drivers and the display direct to it. If the pins of the display are too short, they can be lengthened with the cut-off pins of an IC socket. It is, nevertheless, possible to fit the display and the drivers onto special flat sockets.

The unit may be constructed in the housing of a large electric torch, but a more professional case may be built on the lines of Fig. 8. Such a case is made from fibre glass, which is available in kit form from many car accessory shops for DIY car panel repairs.

Calibration

Before any of the ICs or the EPROM are inserted into their sockets, switch on the supply and set the voltage at pin 24 of the EPROM socket to 5.5 V with P_3.

The ICs and the EPROM should now be inserted into their respective sockets (after



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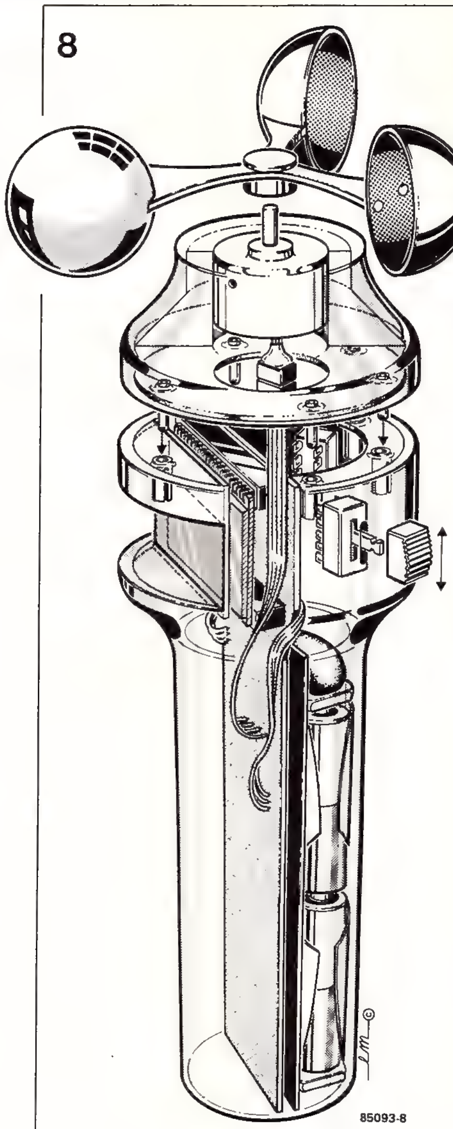


Fig. 8 Suggested construction of the complete anemometer.

the supply has been switched off!). The voltage at pin 24 of the EPROM socket must now be checked with an oscilloscope and, if necessary, P_3 should be readjusted to give 5.5 V.

The supply voltage should now be reduced to 4.5 V, after which P_2 should be adjusted to just cause a LO BAT reading on the display. If the supply voltage is increased slightly, the reading should disappear immediately.

Connect the sensor to the processing unit, and an oscilloscope to pin 6 of IC_{13}. Turn the segmented disc so that the light barrier is open, and adjust P_1 for a clean trapezium-shaped signal on the oscilloscope.

If an oscilloscope is not available, an EPROM programmed as shown in Table 1 may be used. The sensor should then be driven by a small electric motor at about 10 rev/s and P_1 adjusted until the display shows a steady reading of about 160.

The IC_7 count, n, (which is directly proportional to the rotary velocity of the segmented disc) and the wind velocity, v, are related by

$$v=nk$$

where k is a constant.

If at all possible, calibration of the display should be carried out in a wind tunnel but, unfortunately, this is not available to many. The next best thing is to visit your local meteorological station (consult your local telephone directory or ask your local library) on a number of days. Take a series of measurements, note the time, and then ask the station manager for the actual wind forces measured by his station.

```
0000    00 0F 10 0F 20 0F 30 0F 40 0F 50 0F 60 0F 70 0F
0010    80 0F 90 0F 00 01 10 01 20 01 30 01 40 01 50 01
0020    60 01 70 01 80 01 90 01 00 02 10 02 20 02 30 02
0030    40 02 50 02 60 02 70 02 80 02 90 02 00 03 10 03
0040    20 03 30 03 40 03 50 03 60 03 70 03 80 03 90 03
0050    00 04 10 04 20 04 30 04 40 04 50 04 60 04 70 04
0060    80 04 90 04 00 05 10 05 20 05 30 05 40 05 50 05
0070    60 05 70 05 80 05 90 05 00 06 10 06 20 06 30 06
0080    40 06 50 06 60 06 70 06 80 06 90 06 00 07 10 07
0090    20 07 30 07 40 07 50 07 60 07 70 07 80 07 90 07
00A0    00 08 10 08 20 08 30 08 40 08 50 08 60 08 70 08
00B0    80 08 90 08 00 09 10 09 20 09 30 09 40 09 50 09
00C0    60 09 70 09 80 09 90 09 01 00 11 00 21 00 31 00
00D0    41 00 51 00 61 00 71 00 81 00 91 00 01 01 11 01
00E0    21 01 31 01 41 01 51 01 61 01 71 01 81 01 91 01
00F0    01 02 11 02 21 02 31 02 41 02 51 02 61 02 71 02
0100    81 02 91 02 01 03 11 03 21 03 31 03 41 03 51 03
0110    61 03 71 03 81 03 91 03 01 04 11 04 21 04 31 04
0120    41 04 51 04 61 04 71 04 81 04 91 04 01 05 11 05
0130    21 05 31 05 41 05 51 05 61 05 71 05 81 05 91 05
0140    01 06 11 06 21 06 31 06 41 06 51 06 61 06 71 06
0150    81 06 91 06 01 07 11 07 21 07 31 07 41 07 51 07
0160    61 07 71 07 81 07 91 07 01 08 11 08 21 08 31 08
0170    41 08 51 08 61 08 71 08 81 08 91 08 01 09 11 09
0180    21 09 31 09 41 09 51 09 61 09 71 09 81 09 91 09
0190    00 E0 10 E0 20 E0 30 E0 40 E0 50 E0 60 E0 70 E0
01A0    80 E0 90 E0 00 E1 10 E1 E0 E1 30 E1 40 E1 50 E1
01B0    60 E1 70 E1 80 E1 90 E1 00 E2 10 E2 20 E2 30 E2
01C0    40 E2 50 E2 60 E2 70 E2 80 E2 90 E2 00 E3 10 E3
01D0    20 E3 30 E3 40 E3 50 E3 60 E3 70 E3 80 E3 90 E3
01E0    00 E4 10 E4 20 E4 30 E4 40 E4 50 E4 60 E4 70 E4
01F0    80 E4 90 E4 00 E5 10 E5 20 E5 30 E5 40 E5 50 E5
```

Table 1 Hex dump for the calibration EPROM.

Table 2.

Beaufort scale	Description	Wind speed		
		m/s	mph	knots
0	calm	0...0.2	0...1	0...1
1	light air	0.3...1.5	1...3	1...3
2	light breeze	1.6...3.3	4...7	4...6
3	gentle breeze	3.4...5.4	8...12	7...10
4	moderate breeze	5.5...7.9	13...18	11...16
5	fresh breeze	8.0...10.7	19...24	17...21
6	strong breeze	10.8...13.8	25...31	22...27
7	moderate gale	13.9...17.1	32...38	28...33
8	fresh gale	17.2...20.7	39...46	34...40
9	strong gale	20.8...24.4	47...54	41...47
10	whole gale	24.5...28.4	55...63	48...55
11	storm	28.5...32.6	64...75	56...65
12	hurricane	32.6 +	75 +	65 +

Table 2 The Beaufort scale and correlated wind speeds.

Plot the results of each series of measurements. The resulting characteristic should be a fairly straight line with a slight drop-off at low wind speeds (this is caused by friction in the sensor). The slope of the characteristic gives the value of k. If the measurements were suspect, calculate the constant k for each and every measurement from

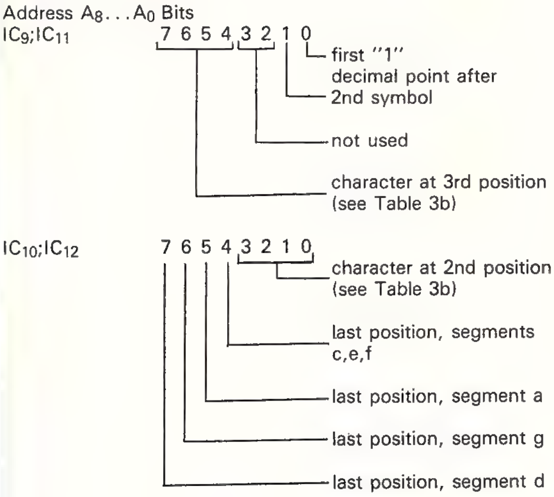
$$k = v/n$$

and from all the results establish a mean value for k.

The values thus found, and their relationship, enable the EPROM to be programmed in line with Table 3.

Note that since S_2 enables the selection of any one of the address ranges 000...1FF; 200...3FF; 400...5FF; and 600...7FF, four different codes (m/s; km/h; knots; and the Beaufort figure) may be programmed.

Table 3(a).



Address $A_8...A_0$ Bits

IC_9;IC_{11} 7 6 5 4 3 2 1 0
- 0: first "1"
- 1: decimal point after 2nd symbol
- 3 2: not used
- 7 6 5 4: character at 3rd position (see Table 3b)

IC_{10};IC_{12} 7 6 5 4 3 2 1 0
- 3 2 1 0: character at 2nd position (see Table 3b)
- 4: last position, segments c,e,f
- 5: last position, segment a
- 6: last position, segment g
- 7: last position, segment d

Table 3(b).

binary	alphanumeric
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	L
1011	H
1100	P
1101	A
1110	—
1111	

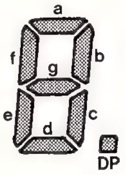


Table 3 (a) Construction of a 512-byte block in the EPROM; (b) Correlation between binary code and alphanumeric character.

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Carline 1¼" holder	0 10

TELEPHONE SPECIAL

B.T App.telephone plug + 3m Lead	£1.25
B T. App. Master Socket, inc. wiring instructions	£2.85
B T. App. Secondary Socket	£1.95
4 way plug each **58p**	10/**£5.50**
B T 4 core cable, per metre	**15p**
100 metres	**£12**
Cable clips for above	100 **75p**

CHART RECORDER SPECIAL

Brand new 3 channel pen recorders complete with charts. Full apwc. upon request once fully price **£40 + £10 p&p + VAT**.

ZENER DIODES

400mW Plastic	3V 30V	each	**8p**	10 **70p**
1 1 3W Plastic	4 7V 120V	each	**12p**	10 **1.10**
* 1 5W Plastic	11V 75V	each	**1.25**	10/**11.50**
* 2 5W Plastic	7 5V 75V	each	**75p**	10/**7.00**
* 15W Plastic	12V 30V	each	**85p**	10 **8 00**
* 20W Metal	7 5V 75V	each	**1 32**	10 **11 60**

* Only available while stocks last

ZENER DIODE PACK - 400 mW
5 each value
11 values individually packed & marked
55 Zener Diodes **£3.50** per pack

NI-CAD

Universal Ni-Cad Charger charges PP3,AA,C,D
Price............... **£6.00**

RECHARGEABLE BATTERIES

AA (HP7)	.85 ea. 10/75p ea.
C (HP11)	1.75 ea. 10/1.65 ea.
D (HP2)	2.05 ea. 10/1.95 ea.
PP3	3.80 ea. 10/3.70 ea.

SPEAKERS

4' Round 1 6W 4 ohm **£1.50** pair
4" Round 1 6W 4 ohm Plus Mounting Bracket. **£1.00** each.
2¼" Round 0.4W 8 ohm. **£0.85** each

D.C. MOTORS (Min.)

6 12V **75p** **£3.00** 5

SCREENED CURLY LEADS

Black 3-core (2 metres extended) **75p.** each **£6.00**/10

CAPACITORS

Mixed Dialectic.

.01mf	1000V	.30
.022mf	1000V	.20
.1mf	1000V	.48
.47mf	1000V	.78

I C SOCKETS

Dil to Dil		
8 pin	0.08	0.70/10
14 pin	0.10	0.90/10
16 pin	0.11	1.00/10
18 pin	0.14	1.30/10
22 pin	0.21	1.80/10
24 pin	0.25	1.90/10
28 pin	0.22	2.00/10
40 pin	0 28	2 60/10

Potentiometers

Carbon Track, Rotary 0.25 W Log & Lin values. All ¼" Spindle, 20 ml body dia, Shaft 2' long.

4K7 — 2M2 Single Gang Log	.32	10/**£3.00**
1K — 2M2 Single Gang Lin	.32	10/**£3.00**
5K — 2M2 Single Gang DP Switch Log	.75	10/**£7.00**
5K — 2M2 Double Gang Log & Lin	.86	10/**£8.25**

DE-LUXE EMERGENCY LITE

Operates from 12V DC, comes complete with 4 metres of cable & cigar lighter plug for easy operation. Magnet base & solid state controlled blinking switch are incorporated. **99p**

CERAMIC CAPACITOR PACK

50V Ceramic Capacitors 5 each value
25 values each value individually marked and packed — 125 total
£3.50 per pack

RESISTORS - CARBON FILM 5%

¼W 1RO to 10M (E12 Range)	**2p** each	**15p**/10 **75p**/100
½W 1RO to 10M (E24 Range)	**2p** each	**15p**/10 **75p**/100
1W 10R to 10M (E12 Range)	**7p** each	**40p**/10 **3.50**/100
2W 1OR to 10M (E6 Range)	**8p** each	**60p**/10 **5.00**/100

RESISTORS - WIREWOUND Generally 5%

4W	1 RO to 10K	1RO 680R	**14p** each
		1K 3K3	**15p** each
		4K7 - 6K8	**18p** each
		10K	**22p** each
7W	1 RO to 22K	1RO - 5K6	**15p** each
		6K8 - 12K	**16p** each
		15K - 22K	**17p** each
11W	1 RO to 22K	1RO - 4K7	**18p** each
		6K8 10K	**19p** each
		15K 22 K	**22p** each
17W	1 RO to 22K	1RO 10K	**24p** each
		15K 22K	**25p** each

Support Pillars for 4W 7W 11W/17W		**4p** each **39p**/10
25W	0.47R - 470R	**1.48** each **12.50**/10
50W	0 47R 470R	**1.85** each **13.00** 10

RESISTOR KITS - each value individually packed

¼W	Pack	10 each	value	E12	- 10R	- 1M	610	pieces	**£ 5.75**
¼W	Pack	5 each	value	E12	- 10R	1M	305	pieces	**£ [illegible] 35**
½W	Pack	10 each	value	E12	- 2R2	2M2	730	pieces	**£ 7.95**
½W	Pack	5 each	value	E12	- 2R2	2M2	365	pieces	**£ 4.75**
1W	Pack	5 each	value	E12	- 10R	- 10M	365	pieces	**£15.00**
2W	Pack	5 each	value	E6	10R	10M	365	pieces	**18.50**

FUSES Prices per 10

20mm Quick Blow. 100, 125, 160, 200, 250, 315, 400, 500, 630 800mA, 1, 1.25, 1 6, 2, 2.5, 3.15, 4, 5, 6.3A. **40p. 20mm Time Delay**. 100, 125,, 160, 200mA **£1.80.** 250, 315, 400, 500, 630, 800mA. **£1.00.** 1, 1.25, 1.6, 2, 2.5, 3.15, 4, 5, 6.3A **85p.** 1" **Mains**. 2, 3, 5, 7, 13A **85p.**

INTEGRATED CIRCUITS (£) EACH

709	35	ML237B	2.30	TBA800	.80
741	.25	NE555	.25	TBA810S	1.20
747	.70	SAA1025	4.00	TBA950/2A	3.05
AN214Q	3.80	SAS560	2.50	TCA2705A	4.02
AN240P	3.42	SAS570	1.85	DA1003A	5.50
BTT6218	1.98	SAS580	2.85	TDA1004	4.95
CA301AT	2.88	SN76023N	2.00	DA1006A	2.45
CA358	0.66	SN76033N	2.50	TDA1035S	2.20
A810QM	1.20	SN76131N	1.99	TDA1170S	1.99
CA3020	2.10	SN76226DN	1.70	TDA1170S	1.99
CA3065	1.60	SN76227N	1.10	TDA1352A	1.80
CA3080E	.68	SN76660N	.75		
CA3130E	.90	SN76666NQ	1.40	2002	1.80
A3140E	.45	STK015	6.20	TDA2020	4.00
HA1366W	1.59	TA7146P	4.60	TDA2030	1.90
LA4422	3.20	TA7203P	2.76	TDA2140	2.90
LC7131	4.90	TA7204P	1.50	TDA2160	2.50
LC7137	5.40	TA7205AP	1.30	TDA2522	2.75
LM324N	45	TA7222P	2.32	TDA2530	2.20
LM380N 8 P	1.15	TAA550	.50	TDA2532	2.80
LM380N 14-P	1.80	TAAG11A12	3.50	TDA2560	3.20
LM1011N	3.20	TAD100	2.90	TDA2581	4.65
LM1458N	.98	TBA120A	.80	UPC575C2	1.45
LM3900N	.85	AS S/SB T/U	.80	UPC741G	.95
M51513L	2.30	TBA120B	1.30	UPC1156H	2.75
M51515L	3.18	SA SQ UQ	1.30	UPC1182H	2.75
MC1307P	1.99	TBA520	1.50	UPC1218H	1.80
MC1327P	1.50	TBA530	1.20	UPC1370C2	2.50
MC1330P	1.60	TBA540	1.64	UPC2002H	2.78
ML232B	2.10	TBA560C	1.50	UPC2002V	2.78

VALVES

A231	4.50	ECL80	.75	PCF802	1.05
A241	1.98	ECL86	1.75	PCF805	1.60
DAF	.96	EF80	.75	PCL82	1.00
DM71	2.95	EF86	1.80	PCL84	1.00
DY86/87	.66	EF91	2.00	PCL86	.90
DY802	.95	EF184	1.00	PCL805	1.05
CV4015	2.80	EL34	3.25	PD500	2.90
EABC80	.98	EL84	1.00	PFL200	1.85
EB91	1.30	EL95	.80	PL36	1.75
ECC81	1.00	EL509	7.85	PL504	1.40
ECC82	.90	EL519	7.95	PL508	2.70
ECC83	1.00	EM84	1.75	PL519	5.15
ECC84	.80	EY86 87	.65	PL802	5.50
ECC85	.95	EY500A	2.50	PY81 800	1.10
ECC86	2.80	EZ80	.75	PY88	.80
ECC88	1.25	GY501	1.40	PY500A	2.20
ECC189	.85	KT66(GEC)	18.00	U26	1.90
ECF80	1.20	KT88(GEC)	19.00	UADC80	.85
ECF86	1.70	PCC189	.85	UCH42	2.50
ECH35	3.75	PCF80	.95	UY41	3.75
ECH42	1.20	PCF84	.75	6AU6	1.00
		PCF87	.50	12AU6	2.00
		PCF800	1.20	30FL12	1.60

MIN. "D" CONNECTORS.

		9way	15way	25way	37way
PLUGS	Solder Lug	.52	.65	.88	1.45
	R. Angle	.89	1.34	1.98	3.48
SOCKETS	Solder Lug	.78	.98	1.33	2.48
	R. Angle	1.18	1.78	2.70	4.15
COVERS		.95	.95	.98	1.00

TERMINAL BLOCKS

2 amp 12 way	20
5 amp 12 way	24
15 amp 12 way	42
32 amp 12 way	88

CMOS

4000	.19
4001	.24
4002	.24
4006	.68

4007	.24	4066	.44	4517	2.70
4008	.59	4067	2.40	4518	.48
4040	.44	4068	.24	4520	.50
4010	.39	4069	.24	4521	1.10
4011	.23	4070	.24	4522	1.20
4012	.24	4071	.24	4526	.58
4013	.35	4072	.24	4527	.64
4014	.58	4073	.24	4528	.68
4015	.58	4075	.24	4531	1.20
4016	.38	4076	.68	4532	.64
4017	.54	4077	24	4536	2.50
4018	.59	4078	.24	4538	.78
4019	.59	4081	.24	4539	.80
4020	78	4082	.24	4541	.94
4021	.58	4085	.58	4543	.70
4022	.68	4086	.58	4549	3.98
4023	.30	4089	1.22	4553	2.40
4024	.49	4093	.37	4554	1.80
4025	.24	4094	.70	4555	.34
4026	.89	4095	.93	4556	.65
4027	.44	4096	.98	4557	2.40
4028	.44	4097	2.65	4558	1.10
4029	.73	4098	.78	4559	3.90
4030	.33	4099	.75	4560	1.50
4031	1.28	4161	.96	4562	3.48
4033	1.25	4162	.96	4566	1.60
4034	1.40	4163	.96	4569	1.75
4035	.68	4174	.96	4583	1.00
4036	2.48	4175	1.00	4584	.54
4038	.73	4195	.99	4585	.55
4039	2.70	4501	.38	40100	2.10
4040	.58	4502	.58	40101	1.20
4042	.48	4503	38	40102	1.30
4043	.42	4507	.45	40103	3.95
4044	.48	4508	1.28		
4046	.58	4510	54	40104	1.15
4049	.38	4511	.54	40105	2.10
4050	.34	4512	.54	40106	.55
4051	.68	4514	1.10	40107	.50
4052	.68	4515	1 20	40108	3.20
4053	.58	4516	.60	40109	.98

TRANSISTORS

Type	Price (£)
AC127	.28
AC128	.30
AC128K	.34
AC141	.58
AC141K	.38
AC142	.56
AC142K	.38
AC151	.45
AC152	.45
AC153	.57
AC153K	.46
AC176	.30
AC176K	.38
AC187	.28
AC187K	.38
AC188	.28
AC188K	.38
ACY22	1.50
AD142	.88
AD143	.88
AD149	.72
AD161	.42
AD161 162	1.20
AD162	.52
AF114	1.20
AF115	2.10
AF116	2.10
AF121	.56
AF124	.42
AF125	.58
AF126	.58
AF127	.38
AF139	.40
AF178	2.28
AF239	.50
AF279S	1.40
AL100	5.40
AL102	4.40
ASY80	5.20
ASZ17	2.00
AU110	2.80
AY102	4.32
B40C2200	1.03
BA110	68
BA115	14
BA121	.40
BA129	.38
BA148	.16
BA155	.12
BAS157	.28
BB105B	.30
BB105G	.48
BC107	.10
A/B	.13
BC108	.10
A B C	.12
BC109	.10
A B C	.14

Type	Price (£)
BC113	.42
BC115	.15
BC116	.12
BC117	.22
BC118	.16
BC119	.28
BC125	.14
BC140	.27
BC141	.26
BC142	.24
BC143	.26
BC147	.18
BC147B	.14
BC148	.10
BC148B	.12
BC149	.10
BC149C	.14
BC157	.10
BC158	.12
BC159	.12
B C	.14
BC160	.30
BC161	.30
BC168B	.20
BC169C	.12
BC170	.16
A/B/C	.16
BC171	.10
A/B	.10
BC172	.12
B/C	.12
BC177	.24
A/B/C	.24
BC182	.10
A B C	.10
BC182L	.12
LA LB LC	.12
BC183	.10
A/B/C	.10
BC183L	.10
LA/LB LC	.10
BC184	.10
A/B/C/L/LA LB	.10
BC207	.15
BC212	.10
A B C	.10
BC212L	.09
LA/LB	.10
BC213	.010
A/B/C	.10
BC213L	.10
LA/LB/LC	.10
BC237	.11
BC238	.12
BC251	.14
A/B	.14
BC262	.26
A/B	.28

Type	Price (£)
BC301	.30
BC302	.30
BC303	.30
BC307A	.18
BC317	.12
BC323	.90
BC327	.16
BC328	.16
BC337	.12
BC338	.12
BC350A	.24
BC351	.16
BC440	.36
BC441	.40
BC461	.58
BC478	.24
BC516	.48
BC547	.12
A/B	.10
BC548	.12
A B/C	.10
BC549	.10
A/B	.10
BC550	.10
A B	.10
BC557A	.10
BC558	.10
A/B/C	.10
BCY70	.16
BCZ10	3.21
BCZ11	2.60
BD124P	.70
BD129	.90
BD130Y	.68
BD131	.36
BD132	.36
BD135	.26
BD136	.26
BD137	.28
BD138	.30
BD139	.30
BD140	.28
BD142	1.60
BD145	1.82
BD150B	.72
BD160	1.58
BD165	.45
BD183	.70
BD201	.52
BD202	.57
BD204	.57
BD222	.80
BD225	.40
BD232	.45
BD234	.30
BD235	.30
BD236	.38
BD237	.38

Type	Price (£)
BD410	.76
BD434	.58
BD438	.58
BD439	.85
BD441	1.00
BD507	1.05
BD520	1.20
BD587	.88
BD707	.74
BDX18	1.00
BDX32	1.48
BF115	.32
BF117	.50
BF119	.82
BF120	.38
BF125	.42
BF127	.44
BF154	.14
BF157	.46
BF158	.30
BF160	.23
BF167	.32
BF177	.42
BF178	.26
BF180	.27
BF181	.27
BF182	.32
BF183	.32
BF184	.30
BF185	.28
BF194A	.15
BF195	.12
BF200	.30
BF222	.38
BF224	.16
BF224J	.20
BF240	.30
BF241	.30
BF244	.34
BF244A	.30
BF257	.22
BF258	.26
BF259	.30
BF262	.34
BF263	.38
BF270	.30
BF271	.28
BF273	.22
BF274	.34
BF294	.46
BF336	.32
BF337	.28
BF338	.28
BF355	.37
BF363	.35
BF367	.24
BF371	.27
BF422	.20

Type	Price (£)
BF450	.38
BF457	.36
BF458	.37
BF459	.35
BFR51	.36
BFR61	.32
BFR90	.86
BFT41	.68
BFT43	.38
BFW11	.84
BFW44	.88
BFX29	.28
BFX48	.78
BFX80	6.46
BFX85	.35
BFY50	.22
BFY51	.22
BFY52	.22
BFY90	.80
BFY90S	1.34
BR100	.25
BR101	.40
BR103	.50
BR303	2.75
BRY39	.50
BRY56	.42
BSX19	.32
BSX20	.30
BSX59	.78
BSX76	.65
BSY52	.35
BSY95A	.25
BT100A/02	.90
BT101/300	2.75
BT101/500	3.25
BT102/300	3.60
BT106	1.15
BT108	1.25
BT109	1.15
BT116	1.20
BT119	3.30
BT120	3.50
BT121	2.99
BT138/600	1.30
BT151 650R	.90
BTY79/400R	2.80
BU100A	2.30
BU104	1.80
BU105	1.20
BU105 02	1.55
BU108	1.75
BU124AE	.98
BU126	1.40
BU133	1.90
BU204	1.30
BU205	1.30
BU206	1.50
BU208	1.40
BU208	1.40

Type	Price (£)
BU208/02	2.05
BU326S	1.75
BU407	1.10
BUX80	3.70
BUY20	2.75
BUY69A	2.60
BUY69B	1.98
BY100	.80
BY103	.50
BY122	.60
BY126	.10
BY127	.08
BY133	.08
BY135	.35
BY164	.45
BY179	.56
BY182	.80
BY184	.38
BY187	.65
BY189	6.75
BY198	.64
BY199	.72
BY206	.14
BY207	.16
BY210/400	.21
BY210/600	.24
BY210/800	.28
BY227	.22
BY228	.46
BY238	.65
BYX10	.20
BYX22/800	.68
BYX36/150	.40
BYX36/600	.48
BYX48/300	.70
BYX55/600	.30
BYX71/600	1.18
BYZ212	.78
C106D (400V)	.48
C106F (50V)	.36
D40C1	1.08
D40N1	1.12
E1222	.30
E5024	.30
GET872	.60
GET881	1.70
GET882	1.90
ITT2001	.18
ITT2003	.34
MCR106/5	1.20
ME0413	.70
ME6002	.26
MEU21	.62
MJ400	1.45
MJ2955	1.00
MJ3000	1.80
MJE340	.46
MJE520	.44

Type	Price (£)
MJE2955	1.60
MJE3055	1.40
MPSA05	.30
MPSA12	.30
MPSL01	.34
MPSU05	1.05
MPSU06	1.18
MR502	.40
MR854	.86
NKT SER.18	1.68
OA91	.07
OA210	.66
OC26	2.65
OC35	4.75
OC44	.72
OC72	.70
OC81	.68
ORP12	.85
R200B	1.20
R2010B	1.20
R2540	2.71
TIC45	.45
TIC47	.70
TIP29	.30
TIP30A	.35
TIP31C	.39
TIP32	.35
TIP33A	.55
TIP34A	.70
TIP41	.42
TIP42	.44
TIP47	.42
TIP121	.63
TIP2955	.70
TIP3055	.58
TIS43	.88
TIS88	.50
TIS90	.27
TV20	2.45
Y728	.14
Y969	2.80
ZE7 5	.60
ZTX107	.14
ZTX502	.22
1N4001	.04
1N4002	.05
1N4004	.05
1N4006	.07
1N4148	.04
1N5400	.12
1N5402	.13
1N5405	.16
1N5406	.17
1N5408	.19
1S44	.06
1S920	.07
2N1306	1.42
2N2122A	.34

Type	Price (£)
2N2222	.30
2N2904A	.48
2N2926G	.14
2N3053	.30
2N3054	.60
2N3055	.65
2N3703	.10
2N3773	2.80
2N3904	.20
2N3906	.20
2N5294	80
2N6107	.80
2SB337	1 80
2SC1098	.94
2SC1172Y	1.70
2SC1173Y	.88
2SC1279	.50
2SC1306	.92
2SC1307	1.50
2SC1413A	2.70
2SC1449	.60
2SC1507	.60
2SC1678	1.00
2SC1758	.68
2SC1909	1.20
2SC1923	.30
2SC1945	2.88
2SC1953	.70
2SC1957	.70
2SC1969	2.80
2SC2028	.73
2SC2029	2.70
2SC2078	1.05
2SC2091	.70
2SC2098	2.90
2SC2122A	3.20
2SC2314	.80
2SC2335	1.50
2SK135	3.80
3N211	3.52
3SK88K	.60
3SK88L	.80
40636	1.65
40673	1.80

74LS

74LS00	.24	74LS14	.48	74LS55	.24	74LS122	.68
74LS01	.24	74LS15	.24	74LS73	.30	74LS123	1.00
74LS02	.24	74LS19	.44	74LS74	.33	74LS124	1.25
74LS03	.24	74LS20	.24	74LS75	.44	74LS125	.52
74LS04	.24	74LS21	.24	74LS76	.38	74LS126	.50
74LS05	.24	74LS22	.24	74LS78	.38	74LS132	.60
74LS08	.24	74LS24	.28	74LS83	.68	74LS135	26
74LS09	.24	74LS26	.24	74LS85	.82	74LS136	.42
74LS10	.24	74LS27	.24	74LS86	.35	74LS138	.44
74LS11	.24	74LS28	.24	74LS90	.48	74LS139	.58
74LS12	.24	74LS30	.24	74LS91	.90	74LS145	.93
74LS13	.33	74LS32	.24	74LS92	.54	74LS147	1.64
		74LS33	.24	74LS93	.54	74LS148	1.28
		74LS37	.24	74LS95	.60	74LS151	.70
		74LS38	.24	74LS96	1.20	74LS153	.70
		74LS40	.24	74LS107	.40	74LS155	.55
		74LS42	.50	74LS109	.44	74LS157	.45
		74LS47	.79	74LS112	.44	74LS158	.58
		74LS48	.85	74LS113	.40	74LS160	.62
		74LS51	.24	74LS114	.39	74LS161	.68

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750	43 34	3.70
1000	55.65	4 20
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2000	86 38	6.36
3000	121 12	0 A
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200	16 47	2.36
250	19 92	2 52
350	24 64	2 84
500	30 69	3.10
1000	55.65	4 20
2000	86.38	5 50
3000	121.14	0 A
6000	258.79	0 A

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12V	24V	Price	P&P
03	15	2.53	96
05	25	2.79	1 10
1	5	3.35	1 38
2	1	4.46	1 20
4	2	5.15	1 60
6	3	8.07	1.70
3	4	9.43	1.86
10	5	10.31	2.05
12	6	11 43	2 15
16	8	13.62	2 33
20	10	18.33	2.66
30	15	22.79	2 85
40	20	32.52	3 78
60	30	46.69	4 50
83	41	53.76	5.50

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196V	36/48	Price	P&P
0 5	1	5 64	1 52
2	4	15 42	2 31
3	6	18.68	2.52
5	10	33.34	3 36
	12	42.38	3 68
8	16	46 23	3 98

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1	2	5.28	1 56
2	4	9.12	1.94
3	6	10.87	2.01
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1	2	7.51	1.66
2	4	9.66	2 00
3	6	13.96	2 10
4	8	15.91	2 31
5	10	20.11	2 36
6	12	22.95	2.78
8	16	32.26	3 20
10	20	37.55	3 57
12	24	43.28	3 68

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9 0 9	1	2.72	.96
9 × 2	0 33 × 2	2.53	96
8 9 × 2	5 × 2	3.53	1 30
8 9 × 2	1A × 2	4.48	96
15 × 2	.2A × 2	2.53	96
12-0-12	05	3.21	96
20 × 2	3 × 2	3.55	1 30
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4	8	10 15	1 99
5	10	12.55	2 10
6	12	14.20	2 30
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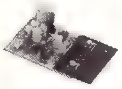

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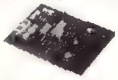

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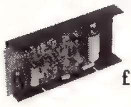

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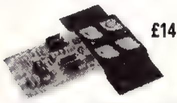

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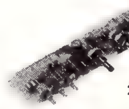

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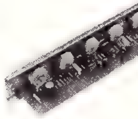

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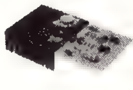

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Today's motor yachtsman is faced with increasingly crowded waters and it is, therefore, more important than ever that he accurately knows not only the speed and direction of his craft, but also the wind angle and speed. Mechanical devices for measuring these quantities on board motor yachts have been in use for many years. Unfortunately, they tend to be cumbersome and cannot be easily displayed in the cockpit. The marine computer presented here, which has worked satisfactorily on board a motor yacht for several seasons*, provides digital read-outs in the cockpit and at the navigator's position of the wind angle relative to the yacht; apparent wind speed; boat speed; trip distance (log); and total distance travelled. At an estimated cost of £200. . .£250, it compares favourably with proprietary systems selling at some £1500.

marine computer

by B Gibbons

The unit operates from a 12 V DC source via a power supply which provides the following voltages (see figure 1).

- 12 V DC for energizing the start-up relay.
- 8 V DC for operating the wind direction system, the Hall effect switch, and the LM 339 comparator.
- 5 V DC for powering the CPU (central processing unit), and the interface and display boards.
- –5 V DC, derived via an inverter from the 8 V line, for operating the analogue-to-digital converter.

A 16 V Type RS283261 transient suppressor deals with any spikes from the charging alternator.

A 4 volt NiCd internal battery ensures retention of memory for up to six months when the craft's supply is switched off. The battery is trickle charged automatically from the boat's power supply.

A 1N4001 diode precludes damage from polarity reversal, and prevents back leakage on power on.

Hardware

Apart from the power supply, the system consists of three transducers (wind speed, wind direction, and boat speed), interface board 2, CPU board 1, cockpit display, and navigator's display. The transducers are connected to the interface board via a 9-pin D-type plug and socket. The interface board and CPU board are fitted to a small backplane by 64-way connectors. The displays are connected to the CPU board by 15-way D-type connectors. The wiring to the D-type connectors is shown in figure 7.

The **wind direction** information is provided by a wind vane which is coupled to the two wipers of a circular resistor, a Penny & Giles Type D40990. This component has three taps at 120° intervals; the resistance between the taps is 2 kΩ. A voltage of 8 V DC is applied across the wipers. The resistor acts as a voltage splitter, so that when the wipers are moved by the wind vane, the voltage at any tap is directly proportional to the angle of the vane. The forward facing tap is connected to pin 14 of the analogue-to-digital converter, IC3, on the interface board via pin 23A of the 64-way connector, and provides the wind angle between 0° and 180°. The other two taps are connected to pins 8 and 9 of comparator IC1 on the interface board via pins 21A and 22 A of the 64-way connector, and provide

1

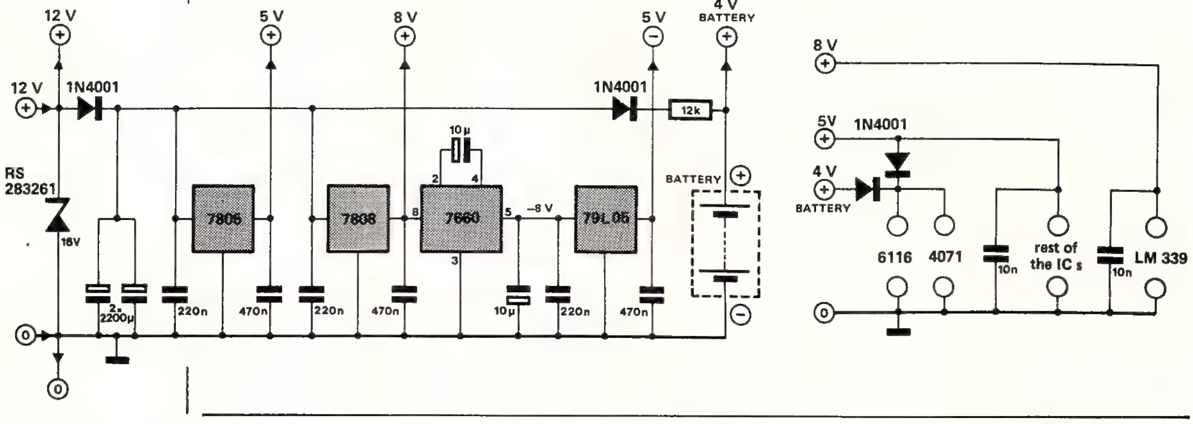

Figure 1. Circuit diagram of the power supply showing the internal back-up battery and supply connections to the various ICs.

---

* Note, however, that it has not been tested in our own laboratories. Ed.

sensing as to port or starboard.

The **wind speed** is ascertained with the aid of an anemometer with two magnets in the base that rotates over a Hall effect switch, which is connected to pin 6 of comparator IC1 on the interface board. The comparator is arranged as a Schmitt trigger to suppress the noise in the long leads (about 20 m) between the Hall effect switch and the interface board. The output of IC1 at pin 1 is used to trigger one of the monostables in IC5 (pin 12). The monostable then provides a 5 ms pulse at its pin 9, which is fed to pin 16 of I/O port B, and then used by the software.

Information as to **boat speed**, **trip distance**, and **total distance** travelled is provided by a small impeller fitted in the hull of the boat. The impeller contains a magnet with an inductor above it. When the impeller is turned by the water, an alternating voltage is induced in the inductor, which is fed to high-gain CMOS amplifier IC7. The output of the amplifier is preset to 2.5 V in the quiescent state by a resistor network. Rotation of the impeller causes an output voltage swing of 0.2 . . . 4.8 V. The output (pin 5) is applied to pin 4 of IC1, whose output at pin 2 is used to trigger the second monostable in IC5 (pin 4). The monostable then provides a 5 ms pulse to pin 15 of I/O port B, from where it is used by the software. This system counts accurately from 1 Hz to 100 Hz.

The speed of the water over the bottom of the boat varies with the shape of the boat. The consequent error in boat speed and distance travelled is negated by a 16-way switch and IC2. The required distance adjustment and speed divider are read at start up.

To ensure correct operation of the CD4543 multiplexers in the display units, 47 kΩ pull up resistors have to be provided to I/O port A (external data bus), and to the

2

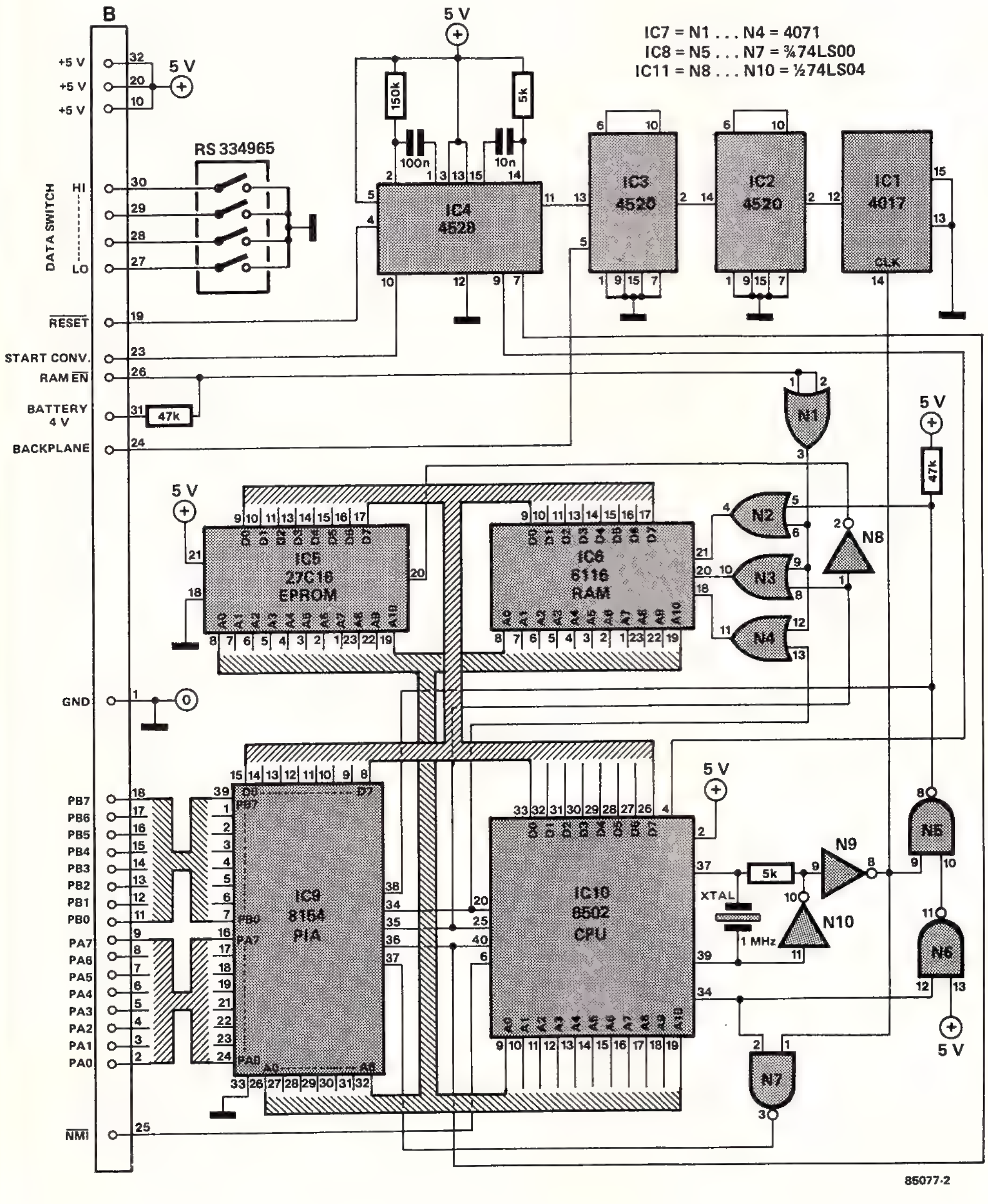

Figure 2. Circuit diagram of the CPU board.

3

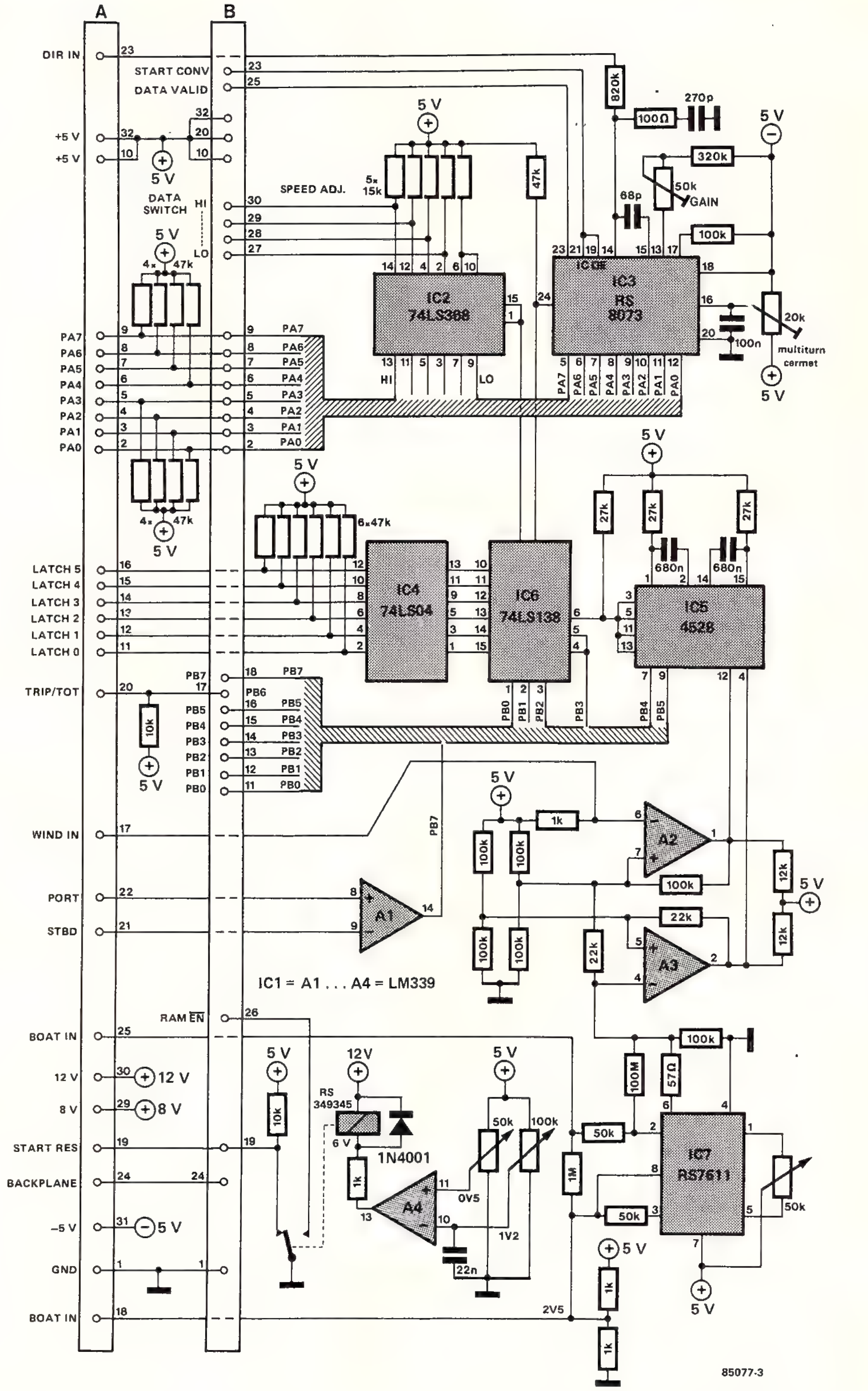

Figure 3. Circuit diagram of the interface board.

outputs of latch IC4 (see figure 3).
The CPU board is of conventional configuration, comprising, apart from microprocessor IC10, a PIA (peripheral interface adapter), IC9, an EPROM, IC5, a static RAM, IC6, a number of OR (IC7) and NAND (IC8) gates, hex inverter IC11, and a divider chain, IC1. . .IC3. This chain divides the 1 MHz clock signal into a 48 Hz signal for the displays (IC3 — pin 5), and a 3 Hz signal for one of the monostables in IC4. The consequent positive going pulse from the monostable (pin 10) starts analogue-to-digital converter IC3 on the interface board.

Software

On reset, the computer sets up the stack, programmes the PIA, clears the trip distance, and reads the setting of the speed & distance adjust switch. This setting is used to correct the distance base and as an index for obtaining the boatspeed divisor.
The main program is a loop that constantly scans ports PB4 and PB5 for a wind

4

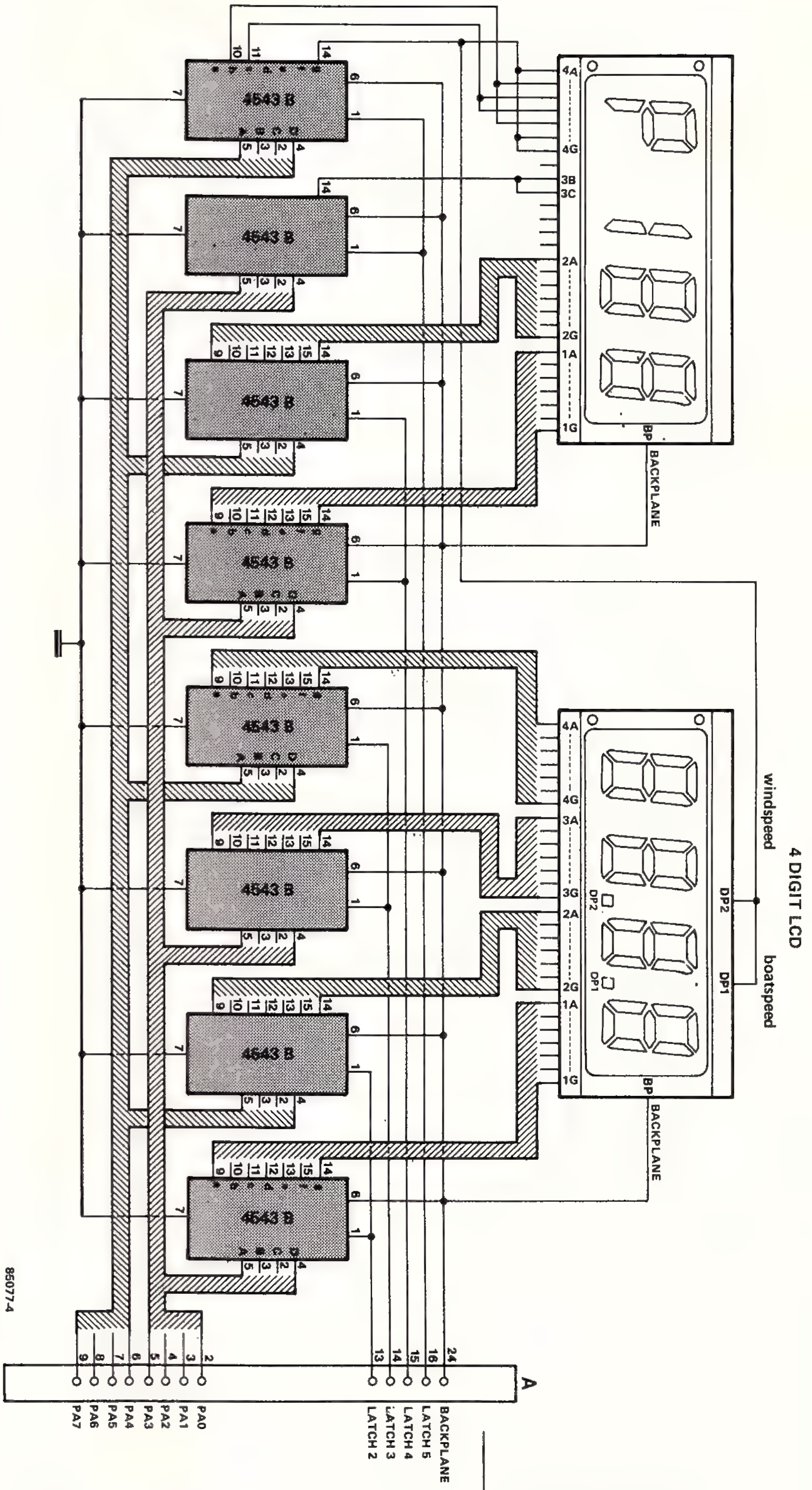

Figure 4. Circuit diagram of the cockpit display unit.

or boat speed signal. If such signals are present, a count to the relevant memory locations takes place, and a flag is set. This flag prevents further counting until the signals have gone. When the flags are cleared, counting can continue on the next signal(s).

IRQ is the system time base and occurs every ⅓ second; it adds up all of the memory locations and then divides them to obtain the average of each of the wind speed, boat speed, and wind direction functions. Each of these is therefore serviced once per second, or very nearly so. The result is stored ready for display. The add-and-divide routine takes 4 ms, hence the need for the 5 ms pulse from the monostables.

NMI is signalled from the analogue-to-digital converter. The signal that starts the conversion is given at the same time as IRQ; conversion takes about 1.25 ms. On NMI, the computer reads the analogue-to-digital converter, stores the result, and puts all the information to the displays.

The **boat speed distance** is based on 256 counts per 1/100 nautical mile. This count is reduced by 4 for every increment of the switch: at setting F, therefore, there are 192 counts per 1/100 nautical mile. As stated before, this is needed to compensate for different boat shapes. The boat speed is a running average of 10 seconds. The trip distance is a straightforward count of boat speed and lapsed time.

The **wind speed** is a running average of 5 seconds. Most boat anemometers are designed to give 1 revolution per 2 knots of wind speed. With 2 magnets, therefore, there is 1 count for every knot of wind, which makes matters very simple indeed.

The **wind direction** is a 2 second running average. The analogue-to-digital converter is set to give an output of 240 (decimal: hex = F0) for 180° of wind (astern). The full scale of the converter is, therefore, used to give optimum resolution. Six readings are taken over 2 seconds, and then divided by 8 to correct the angle.

Construction

The CPU and interface are each constructed on a 100 × 160 mm eurocard. The two cards are fitted to a small motherboard (backplane) by 64-way connectors. The power supply is mounted behind the motherboard, and the whole then fits in a diecast case of 222 × 148 × 55 mm - Fig.8. The displays are housed in plastic waterproof cases, and are connected to the computer by D plugs. All connectors should be high-quality with gold-plated terminals to prevent their rapid deterioration in the harsh marine environment. The cockpit display should be back-lit, preferably red, for night use.

Setting up instructions

Wind direction. Connect pin 23A in Fig. 3 ⟨DIR IN⟩ to ground and adjust the 20 k preset on pin 16 of IC3 until the display reads — and just holds — "000". Next, connect the same pin to the +8 V line and adjust the GAIN control on pin 13 of IC3 for a display reading of 182 or 183. If this cannot be achieved, reduce the 320 k resistor as appropriate (by trial and error). Note that a reading of 182 or 183 is indicated, because in practice it is virtually impossible to achieve 180° (at least, if that is the top display reading).

Wind speed. Disconnect the 1 k pull-up resistor from A17 in Fig. 3 and connect this pin to A24 in Fig. 3. The wind speed should then read 48...49 knots.

5

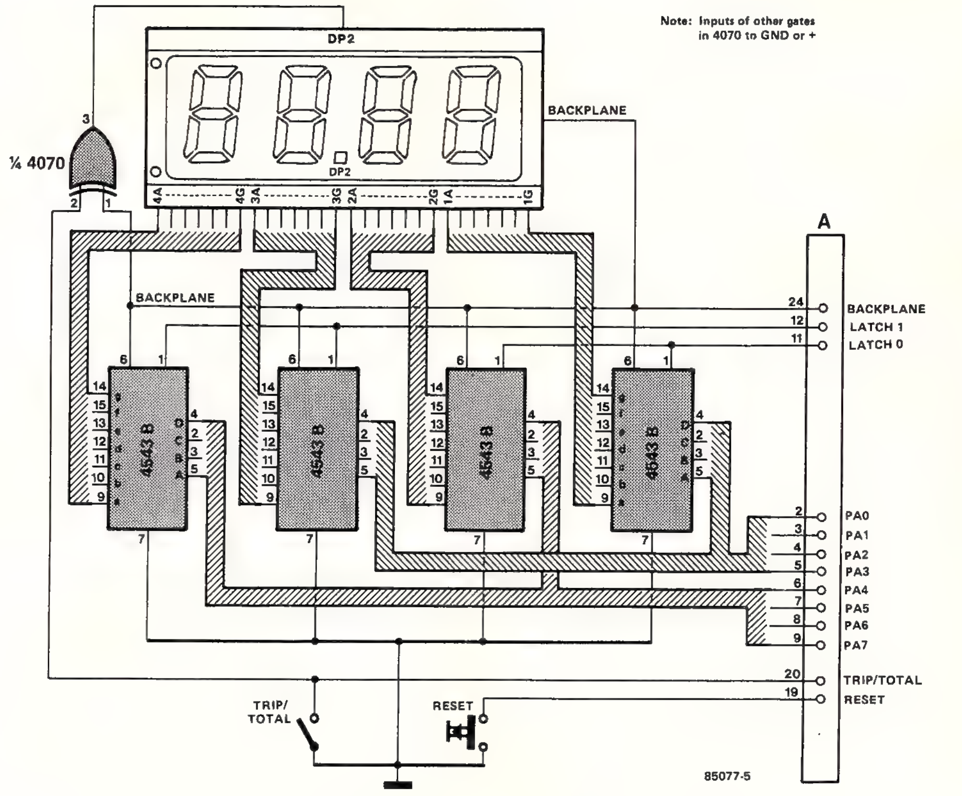

Figure 5. Circuit diagram of the navigator's display unit.

6

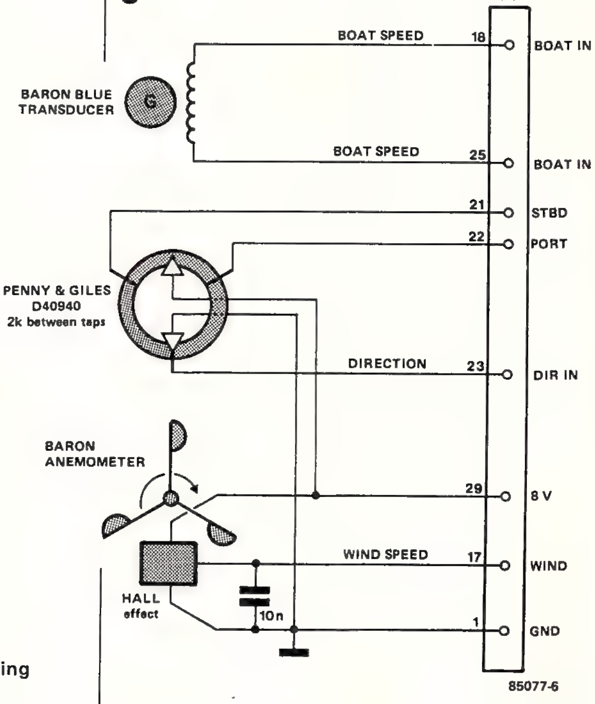

Figure 6. Connecting diagram of the transducers.

Boat speed. Connect pins A18 and A25 ⟨BOAT IN⟩ in Fig. 3 together and adjust the 50 k preset between pins 1 and 5 of IC7 until the potential at pin 4 of A3 is 2.5 V. Next, connect pin A25 to pin A24 ⟨BACKPLANE⟩, when the boat speed should read 6...8 knots with the RS334965 selector (Fig. 2) in position 0, and 8...9 knots with the selector in position 15. Intermediate values can be calculated from

speed display* = 1757/number of counts for 0.01 mile.
*within ±0.1 knot

Initialization. To get zeros in ***E and ***F (boat total distance) on initialization, short-circuit pins 1 and 2 of gate N1 in Figure 2 to ground, and switch the supply on and off a couple of times until zeros appear on the distance display. Disconnect the short before finally switching off, when the zeros should be maintained. If blanks apear on the display initially, this is because outputs over 9 are not displayed. The actual total distance displayed is not important, but needs to be maintained in

7

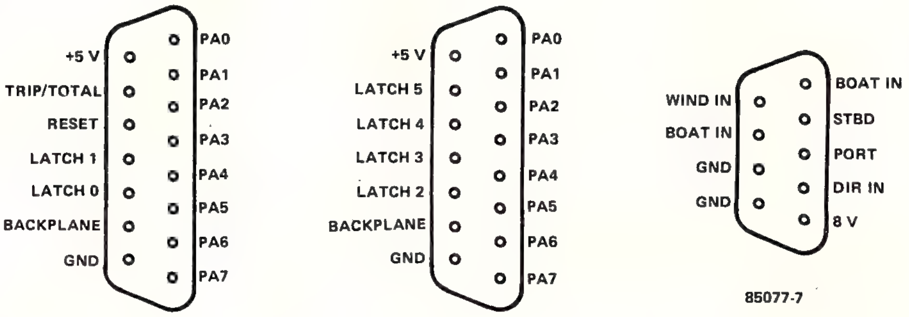

Figure 7. Pin layout of the D-type connectors.

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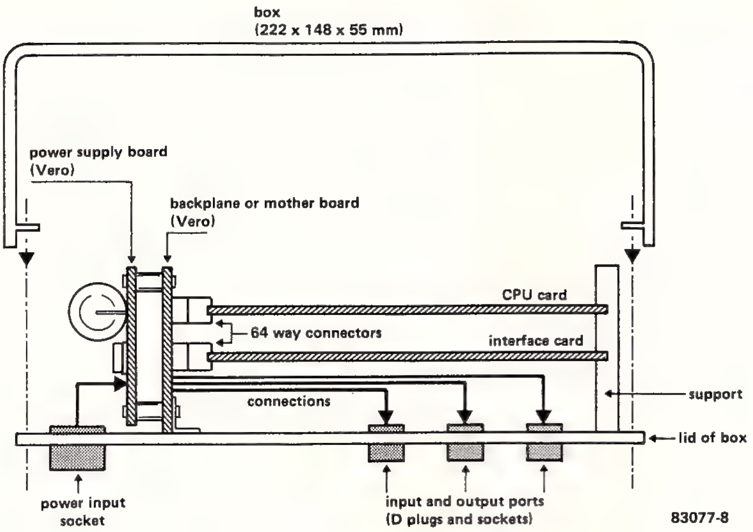

Figure 8. Construction plan of the control unit.

```
        D800,E000
       0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F
D800: FF FF FF FF FE FF FF FF FC F9 F0 EE F6 BF F2 FE ................
D810: FF FF FE FF FF FF FF FF F4 FE F2 F7 F8 DF F8 F5 ................
D820: FB FF FF FF FE FF FF FF F8 FF F7 FF F2 FF F3 DF ................
D830: F7 FF FF FF FF FF FF FF F2 FF F2 FA FE FD F6 D9 ................
D840: FF FF FF FF FF FB FE FF FA FF F8 FD F2 FB FE D7 ................
D850: FF FE FF FF FF FF FF FF F0 98 F9 DF FA F8 F0 F7 ................
D860: FF FF FF FF FD FF FF FF F2 F6 F0 F7 F1 F5 F0 FE ................
D870: FF FF FF FF FF FF FF FF F1 FF F0 E3 F8 EE F0 FB ................
D880: FF FF FF FF FE FF F7 FF F4 FF F8 FA F8 ED F2 FF ................
D890: FD FF FF FF FF FF FF FF F4 DD F1 FF F0 FF F2 DE ................
D8A0: FF FF FF FF FF FF FF FF F2 FD F4 F3 F2 F3 F0 D7 ................
D8B0: FF FF FF FB FF FF FF FF F0 FF F1 FD F1 F9 F7 FE ................
D8C0: FE FF FF FF FF FF FF FF F0 FF F1 FF F4 9B F1 FE ................
D8D0: FF FF FF FF FF FF FF FF F5 F6 F1 CF F2 F5 F2 DE ................
D8E0: FF FF FF FF FF FF FF FF F0 FF F0 FF F0 E6 F0 D7 ................
D8F0: FF FF FF FF FF FF FF FF F1 FF F0 FF F9 FF F1 FE ................
D900: A2 FF 9A E8 86 0C 86 0D A9 80 85 09 85 0A 85 0B ................
D910: A9 0F 8D 23 0E A9 06 8D 21 0E AD 20 0E 8D 1B 0E ...#.....!.. ....
D920: 29 3F 85 10 4A 4A A8 B9 00 FF 85 15 A9 49 85 16 )?..JJ.......I..
D930: A9 20 85 2A A9 30 85 35 A9 40 85 46 58 D8 AD 0C . .*.0.5.$.FX...
D940: 0E 30 06 A9 00 85 17 F0 36 A5 17 30 32 E6 19 D0 .0......6..02...
D950: 1F A5 10 85 19 18 F8 A5 0C 69 01 85 0C 90 11 65 .........i.....e
D960: 0D 85 0D 18 A5 0E 69 01 85 0E 90 04 65 0F 85 0F ......i.....e...
D970: F8 A6 2A 18 B5 00 69 01 95 00 D8 A9 80 85 17 AD ..*...i.........
D980: 0D 0E 30 06 A9 00 85 18 F0 13 A5 18 30 0F F8 A6 ..0.........0...
D990: 35 18 B5 00 69 01 95 00 A9 80 85 18 D8 4C 3E F9 5...i........L>.
D9A0: FF FF FF FF FF FF FF FF F1 FF F3 EF F3 FD F2 FB ................
D9B0: FF FF FF FF FF FF FF FF F4 FF F0 FA F5 FB F1 DF ................
D9C0: FF FF FF FE FF FF FF FF F6 FE F5 FF F4 FF F2 FF ................
D9D0: FE FF FF FF FF FF FF FF F8 DE F0 FE FE F7 F8 FD ................
D9E0: FF FF FF FF FF FF F7 FF F1 FB FE FC F9 BE F7 DF ................
D9F0: FF FF F7 FF FF FF FF FF F1 FF F0 FF FD FF F1 FF ................
DA00: 48 98 48 8A 48 A5 09 30 08 A5 0A 30 59 A5 0B 30 H.H.H..0...0Y..0
DA10: 53 A2 21 F8 A0 00 84 05 A5 20 18 75 00 90 02 E6 S.!...... .u....
DA20: 05 E8 E0 2A F0 02 D0 F2 06 05 06 05 06 05 06 05 ...*............
DA30: A8 0A 0A 0A 0A 85 06 98 4A 4A 4A 4A 18 65 05 85 ........JJJJ.e..
DA40: 05 A5 15 85 07 20 00 FD A5 01 85 11 A9 00 85 09 ..... ..........
DA50: A2 80 86 0A A6 2A E8 E0 2A D0 02 A2 20 86 2A 95 .....*..*... .*.
DA60: 00 4C 22 F8 30 55 A2 30 F8 A0 00 84 05 B5 00 18 .L".0U.0........
DA70: E8 E0 35 F0 08 75 00 90 F6 E6 05 B0 F2 06 05 06 ..5..u..........
DA80: 05 06 05 06 05 A8 0A 0A 0A 0A 29 F0 85 06 98 4A ..........)....J
DA90: 4A 4A 4A 18 65 05 85 05 A5 16 85 07 20 00 FD A5 JJJ.e....... ...
DAA0: 01 85 12 A2 80 86 0B A9 00 85 0A A6 35 E8 E0 35 ............5..5
DAB0: D0 02 A2 30 95 00 86 35 4C 22 FB 18 D8 A0 00 A2 ...0...5L"......
DAC0: 40 B5 00 18 E8 E0 46 F0 07 75 00 90 F6 C8 B0 F3 $.....F..u......
DAD0: 4A 4A 4A 85 00 98 0A 0A 0A 0A 0A 18 65 00 85 00 JJJ.........e...
DAE0: A2 01 86 0B A9 00 F8 46 00 90 02 69 00 46 00 90 .......F...i.F..
DAF0: 02 69 01 46 00 90 02 69 03 46 00 90 02 69 07 46 .i.F...i.F...i.F
DB00: 00 90 02 69 15 46 00 90 02 69 31 46 00 90 04 69 ...i.F...i1F...i
DB10: 63 B0 06 46 00 90 03 69 27 E8 85 14 86 13 A9 80 c..F...i'.......
DB20: 85 09 D8 68 AA 68 A8 68 40 FD F5 F7 F4 FE F0 EE ...h.h.h$.......
DB30: FF FF FF FF FF FF FF FF F6 FF F4 FD F5 FE FD FE ................
DB40: FF FF FF FF FF FF FF FF F0 DE F1 FF FC FF F0 E2 ................
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DBB0: FF FF FF FF F7 FF FE FF FA FF F0 FF F5 F5 F0 F9 ................
DBC0: FF FF FF FF FE FF FF FF F0 7F F8 F7 F0 FE FD FA ......... ......
DBD0: FF FF FF FF FF FF FF FF FD FF FC FF F4 FF F0 FF ................
DBE0: FF FF FF FF FE FE FF FF F8 DF F4 FB FA FF FA FF ................
DBF0: FF FF FF FF FF FF FF FF F8 FF F0 FF F6 FF F2 FF ................
```

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DC00: 48 98 48 8A 48 A9 07 8D 21 0E AD 20 0E 8D 1B 0E H.H.H...!.. ....
DC10: A6 46 95 00 E8 E0 46 D0 02 A2 40 86 46 A9 FF 8D .F....F...$.F...
DC20: 22 0E A2 20 AD 0F 0E 30 02 A2 50 8A 05 13 8D 20 ".. ...0..P....
DC30: 0E A9 05 8D 21 0E 8D 1B 0E A5 14 8D 20 0E A9 04 ....!........ ...
DC40: 8D 21 0E 8D 1B 0E A5 11 8D 20 0E A9 02 8D 21 0E .!........ ....!.
DC50: 8D 1B 0E A5 12 8C 20 0E A9 03 8D 21 0E 8D 1B 0E ...... ....!....
DC60: A6 0C A4 0D AD 0E 0E 30 04 A6 0E A4 0F 8C 20 0E .......0...... .
DC70: A9 01 8D 21 0E 8D 1B 0E 8E 20 0E A9 00 8D 21 0E ...!..... ....!.
DC80: 8D 1B 0E 8D 22 0E 68 AA 68 A8 68 40 FF FF FF FF ....".h.h.h$....
DC90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DCA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DCB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DCC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DCD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DCE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DCF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FE ................
DD00: F8 A2 00 86 00 86 01 86 02 A5 05 A8 4A 4A 4A 4A ............JJJJ
DD10: 85 03 98 29 0F 85 04 A5 06 A8 4A 4A 4A 4A 85 05 ...)......JJJJ..
DD20: 98 29 0F 85 06 A2 03 A0 00 18 98 75 00 38 E5 07 .).........u.8..
DD30: 90 0C A8 18 A9 01 65 01 85 01 98 38 B0 F0 A8 A5 ......e....8....
DD40: 02 C9 00 F0 10 38 E9 01 85 02 18 A9 01 65 01 85 .....8.......e..
DD50: 01 98 38 B0 D9 98 18 65 07 A8 29 F0 4A 4A 4A 4A ..8....e..).JJJJ
DD60: 85 02 98 29 0F 0A 0A 0A 0A A8 E8 8A C9 07 F0 1E ...)............
DD70: A5 00 0A 0A 0A 0A 85 00 A5 01 4A 4A 4A 4A 18 65 ..........JJJJ.e
DD80: 00 85 00 A5 01 0A 0A 0A 0A 85 01 38 B0 98 D8 60 ...........8...`
DD90: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DDA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DDB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DDC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DDD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DDE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DDF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DE00: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DE10: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
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DEA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DEB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DEC0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DED0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
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DEF0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DF00: 69 68 67 66 65 64 63 62 61 60 58 57 56 55 54 53 ihgfedcba`XWVUTS
DF10: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
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DFA0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DFB0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
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DFD0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DFE0: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF ................
DFF0: FF FF FF FF FF FF FF FF FF FF 00 FC 00 F9 00 FA ................
E000: 00
```

Table 1. Data stored in EPROM (IC5 in Fig. 2); the EPROM is available under reference 538. Note that owing to a transposition from one computer to another the addresses in this table read D***, whereas they should, of course, read F***.

the event of a temporary power failure or accidental operation of the reset button.

Calibration on board. Set the water transducer in line with the prevailing water flow until the highest speed is indicated. Make several runs at steady speed over a measured distance, making allowance for tide, and adjust the selector switch until displayed and calculated distances and speeds are the same. Press the reset button after each adjustment to read the new selector value.

Finally. If the instrument is taken off the boat, for instance, during the winter season, connect the 12 V power input pins together to reduce the drain on the back-up battery.

Baron Instruments Ltd
6 West Wycombe Road
High Wycombe
Bucks HP11 2LG

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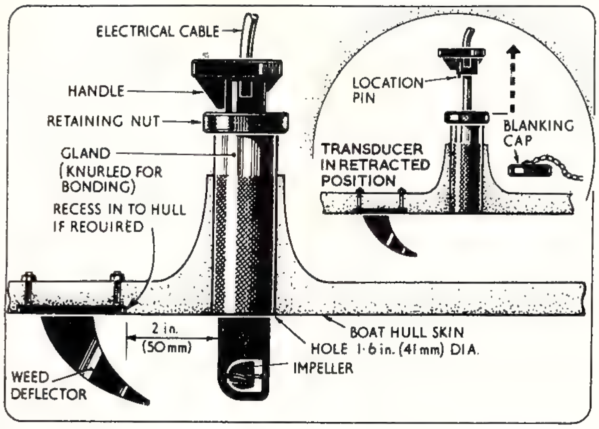

Figure 9. Mounting details of the water transducer for glass fibre hulls.

10

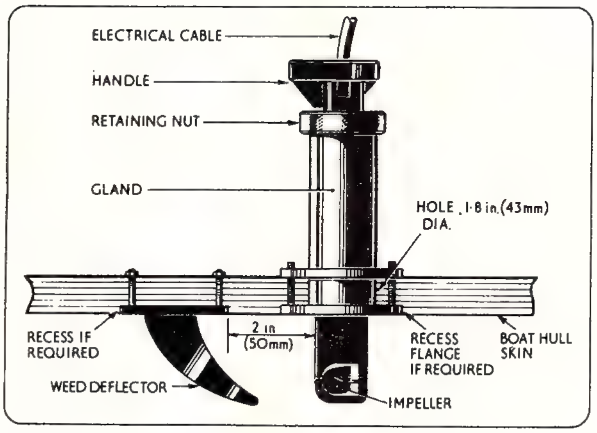

Figure 10. Mounting details of the water transducer for timber hulls.

11

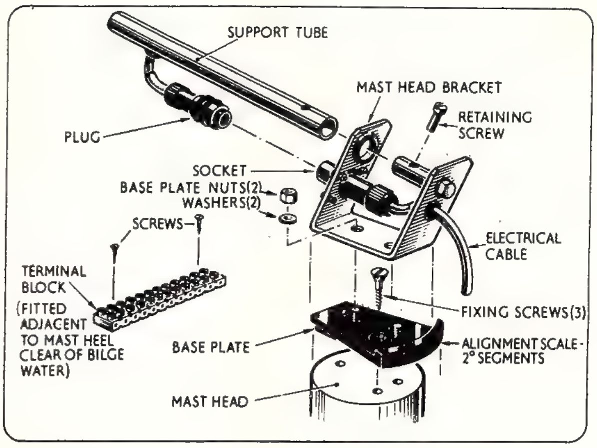

Figure 11. Masthead mounting details of the wind transducer.

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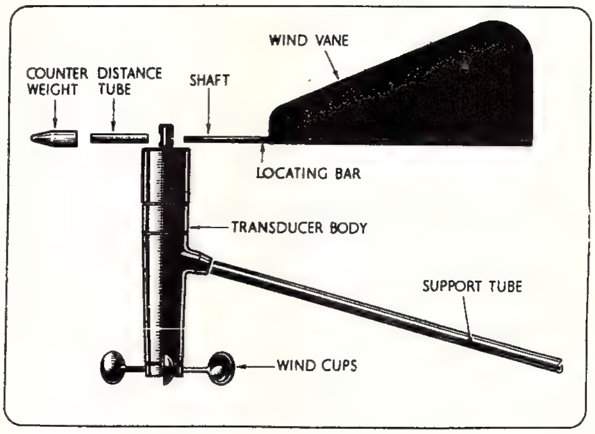

Figure 12. Wind vane assembly.

design ideas

clock oscillators

An oscillator is a circuit that converts direct-current power into alternating-current power, in contrast to a generator, which is a device that converts mechanical energy into electrical energy.

There are, basically, two categories of oscillator that are of interest to the electronics engineer: harmonic and relaxation. The former produce sinusoidal waveforms and contain at least one active element that supplies power constantly to the passive components, whereas relaxation oscillators produce non-sinusoidal waveforms, such as rectangular pulses.

An oscillator is generally an amplifier operating with positive feedback in a manner whereby an output is produced without any input signal. To achieve the desired frequency, every oscillator contains a frequency-determining part, which may be an *LC* circuit, a phase-shifting *RC* network, or a quartz crystal.

Clock oscillators are the simplest of crystal oscillator, which may, none the less, have an overall accuracy of 50 p.p.m. These oscillators form the backbone of the vast majority of digital circuits.

The amplification of an amplifier operating with positive feedback is given by

$$A' = \frac{A}{1-\beta A} \qquad (1)$$

where A' is the amplification with feedback; A is the open-loop amplification; and β is the portion (expressed as a vulgar or decimal fraction) of the output that is fed back to the input.

In designing oscillators, it is necessary to control the feedback in a manner whereby $\beta A = 1$ (the Barkhausen criterion) is true at only one frequency: the desired frequency. When this criterion is met, an output signal exists even when the input signal is zero.

The quartz crystal

A quartz crystal is cut from a bar of manufactured quartz. If an alternating electric potential is applied across a certain direction (related to Young's modulus) of the crystal, mechanical vibrations result. If the frequency of the applied potential corresponds to a natural frequency of vibration of the crystal, very powerful vibrations are set up, which, in turn, cause an alternating field across the crystal. The mechanical vibrations suffer little from damping and have a sharp resonance peak.

The equivalent circuit of a quartz cyrstal is shown in Fig 1. Note that C_1, L, and R_1 are not true electrical components, but merely serve to illustrate the performance of a crystal vibrating at, or near, its resonance frequency, while C_0 is the electrostatic capacitance of the electrodes, and R_2 is the connection resistance, which normally has such a low value that it can be ignored. Typical values for a 100 kHz crystal are $L = 85$ H; $C_1 = 0.03$ pF; $R_1 = 280\ \Omega$; and $C_0 = 3.5$ pF.

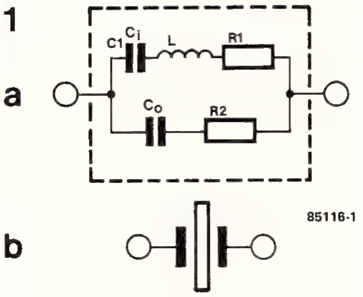

Fig. 1 (a) Equivalent circuit of quartz crystal, and (b) circuit symbol.

The series-parallel equivalent circuit shows that there is both a series resonant frequency, f_s (zero impedance), and a parallel resonant frequency, f_p (infinite impedance). The series resonant frequency is

$$f_s = \frac{1}{2\pi\sqrt{LC_1}}\ [\text{MHz}] \qquad (2)$$

The parallel resonant frequency is

$$f_p = \frac{1}{2\pi\sqrt{LC}}\ [\text{MHz}] \qquad (3)$$

where

$$C = \frac{C_1 C_0}{C_1 + C_0} \qquad (4)$$

From (2) and (3) it is evident that the parallel resonant frequency is always greater than the series resonant frequency, although, since $C_0 >> C_1$, they are very close.

If the modulus of impedance, |Z|, of the crystal is plotted as a function of the frequency, a characteristic curve as shown in Fig. 2 is obtained. When the frequency is increased beyond the parallel resonant frequency, the crystal behaves again as a capacitance (as it did below f_s). At about three times the fundamental resonant frequency, there is again a series and a parallel resonance: this is called the third harmonic frequency of the crystal. The physical representation of how a crystal can vibrate at three times its fundamental frequency is given in Fig. 3. The thin quartz disc is deformed longitudinally, but the deflection at the suspension points remains zero, so that only vibrations that are an odd multiple of the fundamental frequency can take place. Modern crystals are available with fundamental frequencies from a few kHz up to about 30 MHz, third harmonics from 20...90 MHz, and fifth harmonics from 60...150 MHz. Note that the mode of vibration is primarily dependent upon the thickness of the plate.

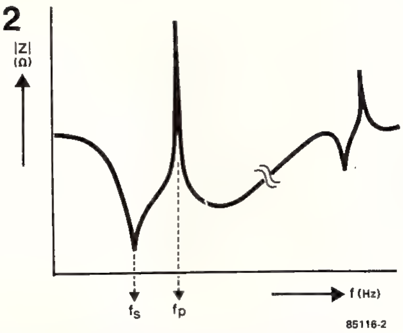

Fig. 2 Modulus (=magnitude) of impedance plotted against frequency.

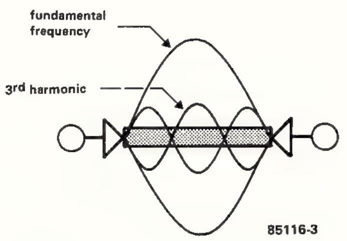

Fig. 3 Physical representation of a vibrating crystal.

Requirements of a clock oscillator

Clock oscillators must be reliable, easily reproducible, and simple. An example of such an oscillator is shown in Fig. 4. This operates in the parallel mode, which generally means at fundamental frequency. The dynamic capacitance (C_1 in Fig. 1) and capacitors C_1 and C_2 form a capacitive divider, which means that the inverting amplifier needs a high impedance input and output (whence the current source symbol at its output). The output current should not exceed a certain maximum value, otherwise the

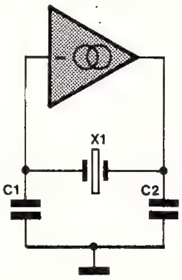

Fig. 4 Circuit of a simple clock oscillator operating in the parallel mode.

crystal may become damaged. Also, since some of the energy is converted into heat by R_1, an excessive current may adversely affect the stability. In general, the power supplied to crystals operating in the 2...30 MHz range should not exceed 10 mW: a safe value is 1...3 mW. Some special crystals for operation below 2 MHz should not be supplied with more than 100 μW.

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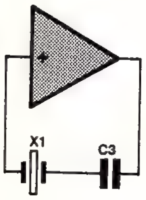

Fig. 5 Circuit of a series-mode oscillator, which is, however, not very reliable in operation.

A series-mode oscillator, Fig. 5, uses a non-inverting amplifier, so that both the input and the output are low impedance. This type of circuit is not very reliable. For instance, when the Q of the crystal is not very high, the oscillator may work as an astable multivibrator (AMV).

The quality factor, Q of a crystal is

$$Q = \frac{2\pi f_s L}{R_1} = \frac{1}{2\pi f_s C_1 R_1} \qquad (5)$$

Even fundamental frequency crystals may, in a series-mode circuit, prefer to work on the third harmonic. It is, therefore, advisable that, in general, clock oscillators use parallel-mode circuits.

Overtone oscillators

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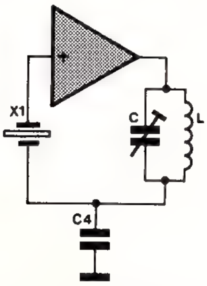

Fig. 6 A series-mode oscillator can be made to operate on the third harmonic by the use of a notch filter tuned to the fundamental frequency.

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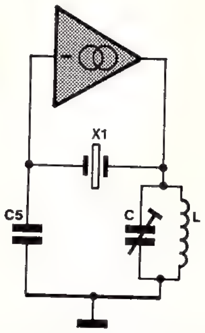

Fig. 7 A parallel-mode oscillator can operate on harmonic frequencies (to which the *LC* circuit is tuned), but this is rarely done in practical circuits.

Oscillators intended for operation on harmonics of the crystal frequency are called overtone oscillators. The series-mode overtone oscillator of Fig. 6 needs a notch filter, L-C-C_4, tuned to the fundamental crystal frequency, for satisfactory operation. In the parallel-mode overtone oscillator of Fig. 7, however, it is sufficient that either the input or the output of the active element is tuned to, or, rather, to just below, the harmonic, because the modulus of impedance must be capacitive. Although the circuit of Fig. 7 is suitable for operation at up to the fifth harmonic, it is rarely used in practice.

Practical circuits

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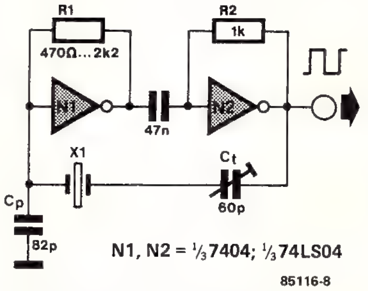

Fig. 8 One of the most common crystal oscillator circuits using TTL gates.

The most frequently encountered oscillator using NOT gates (inverters) is shown in Fig. 8. This series-mode circuit is suitable for operation between 1 and 8 MHz. Fine adjustment of the frequency is provided by trimmer C_t. If the required frequency accuracy is not great, the trimmer may be omitted. Capacitor C_p prevents operation on a harmonic frequency. The value of R_1 is 2k2 for operation below 2 MHz. The value of R_2 is calculated from

$$R_2 = 3000/f_c \; [\Omega] \qquad (6)$$

where f_c is the crystal frequency in MHz.

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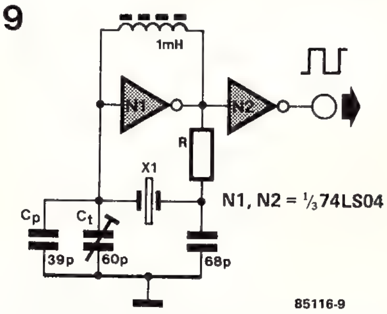

Fig. 9 Although this parallel-mode oscillator using low-power Schottky TTL gates needs fewer components than its series-mode counterpart, it is hardly ever found in practice.

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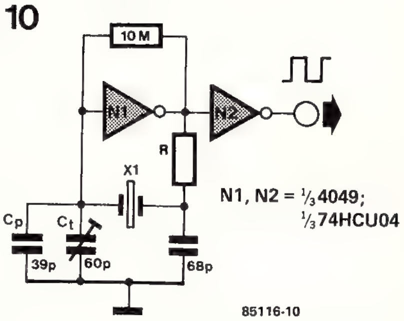

Fig. 10 When unbuffered high-speed CMOS gates are used, the parallel-mode oscillator is second to none.

A better oscillator using inverter gates is given in Fig. 9; it operates in parallel mode. Resistor R serves to limit the current through the crystal. If fine frequency adjustment is not required, C_t may be omitted and C_p increased to 56 pF. This circuit is suitable for use between 1 and 30 MHz.

Whereas the oscillators in Fig. 8 and 9 are intended for use with low power Schottky - LS - gates, that in Fig. 10 uses high-speed CMOS devices. Reliable operation is guaranteed up to 30 MHz. The value of R is computed from

$$R = 10^4/f_c - 300 \; [\Omega] \qquad (7)$$

where f_c is the crystal frequency in MHz.

Since the output impedance of the gates is fairly low, it is necessary to connect a resistor in series with the output to prevent damage to, or destruction of, the crystal. It would be better to use a control system, but that is not easy to realize with gates.

If, however, the oscillator uses discrete components, output control may be achieved in a convenient manner — see Fig. 11. The active element in this circuit is a dual-gate MOSFET. The interesting feature of this circuit is that the DC bias is obtained by feedback from the drain to gate G_2. Diode D_1 in the feedback loop ensures that the potential at G_2 drops as soon as the signal at the drain exceeds 1.5 V_{pp}. This causes a reduction of the current through T_1, which limits the peak output of the oscillator.

A high drain impedance is obtained by connecting a 10 mH choke, L_1, in series with R_3.

Transistor T_2 is not required if the output of the MOSFET is AC coupled to a trigger circuit (LS or HC MOS).

design ideas

The oscillator of Fig. 11 is intended for operation with fundamental frequency crystals in the parallel mode over the frequency range of 0.1...30 MHz. It can, however, easily be modified for operation on harmonics. To this end, R_4 is replaced by an *LC* circuit tuned to the desired harmonic — see Fig. 12. When this circuit is required to operate at frequencies above about 45 MHz, a BFR91 should be used in the T_2 position, and R_5 should be reduced to about 220 Ω. The value of L_2 is determined by

$$L_2 = 724/f_c^2 \, [\mu H] \qquad (8)$$

where f_c is the crystal frequency in MHz.

A *Q* value of around 30 is sufficient.

The oscillator of Fig. 12 is suitable for operation at frequencies up to 100 MHz. The L_2C_x circuit is tuned to the correct frequency, i.e., the third or fifth harmonic, with the help of a frequency counter. If such a counter is not available, connect the detector of Fig. 13 to the output and turn the trimmer until the meter deflects. Turning the trimmer even further will cause the oscillator to switch off. The correct position of C_x is about midway between the two points thus found. If this position is far from the centre position, the value of L_2 is incorrect, or the circuit is tuned to the wrong harmonic.

13

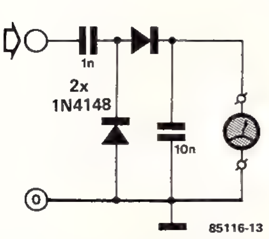

Fig. 13 This detector circuit can be used to tune the L_2-C_x circuit in Fig. 12 if a frequency counter is not available.

14

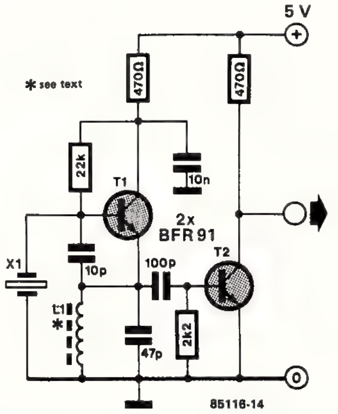

Fig. 14 This oscillator for operation on 3rd harmonic frequencies need not be tuned.

Another type of third-harmonic oscillator is shown in Fig. 14. The resonant frequency of the *LC* circuit is

$$f_{res} = 0.63 f_3 \text{ [MHz]} \qquad (9)$$

where f_3 is the frequency of the third harmonic in MHz.

This circuit does not need trimming, because at the fundamental frequency it is inductive and can, therefore, not oscillate. At the third harmonic it is capacitive, however, so that oscillating is possible. The value of *L* is calculated from

$$L = 1616/f_3^2 \, [\mu H] \qquad (10)$$

where f_3 is the frequency of the third harmonic in MHz. ◾

11

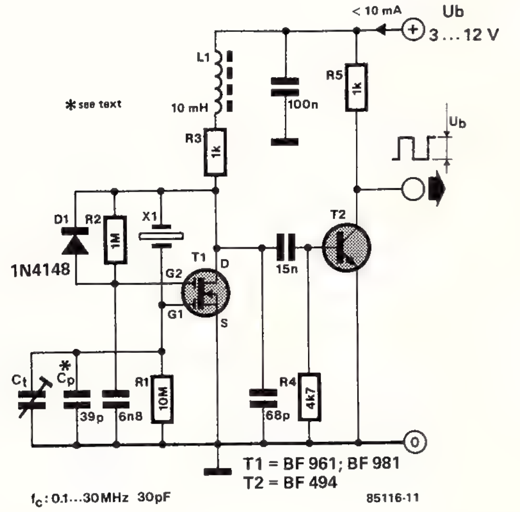

Fig. 11 The best oscillators still use discrete components; this circuit is intended for operation on the fundamental crystal frequency.

12

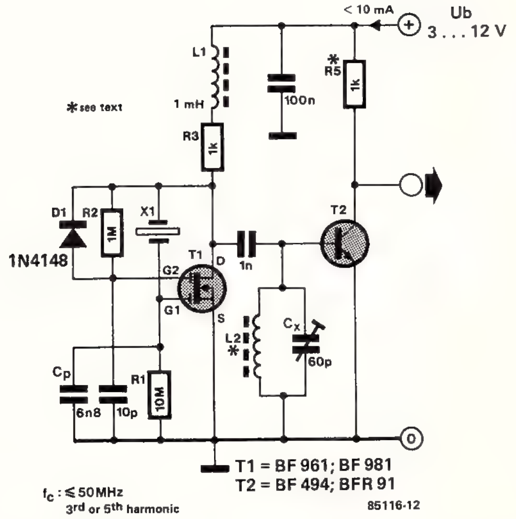

Fig. 12 A few small modifications make the circuit of Fig. 11 suitable for operation on harmonic frequencies.

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corrections

versatile counter circuit

(March 1985 — p. 3-54)
Addendum. When two or more counter elements are connected in cascade, it is important that the CI lines, and the CO lines, are interconnected. These connections are shown incorrectly in Fig. 5.

VLF converter (050)

(July & August 1985)
Addendum. Pins 1, 4, 6, 9, and 14 should have been shown connected to earth.

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- Remove the photo-sensitive film from the copper tracks with wire wool and drill the holes.

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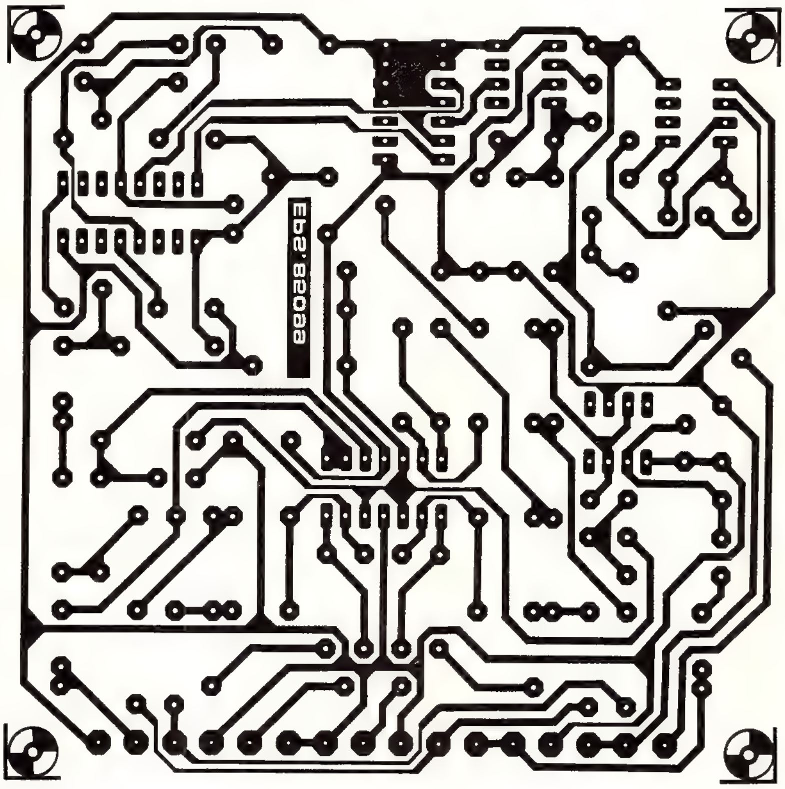

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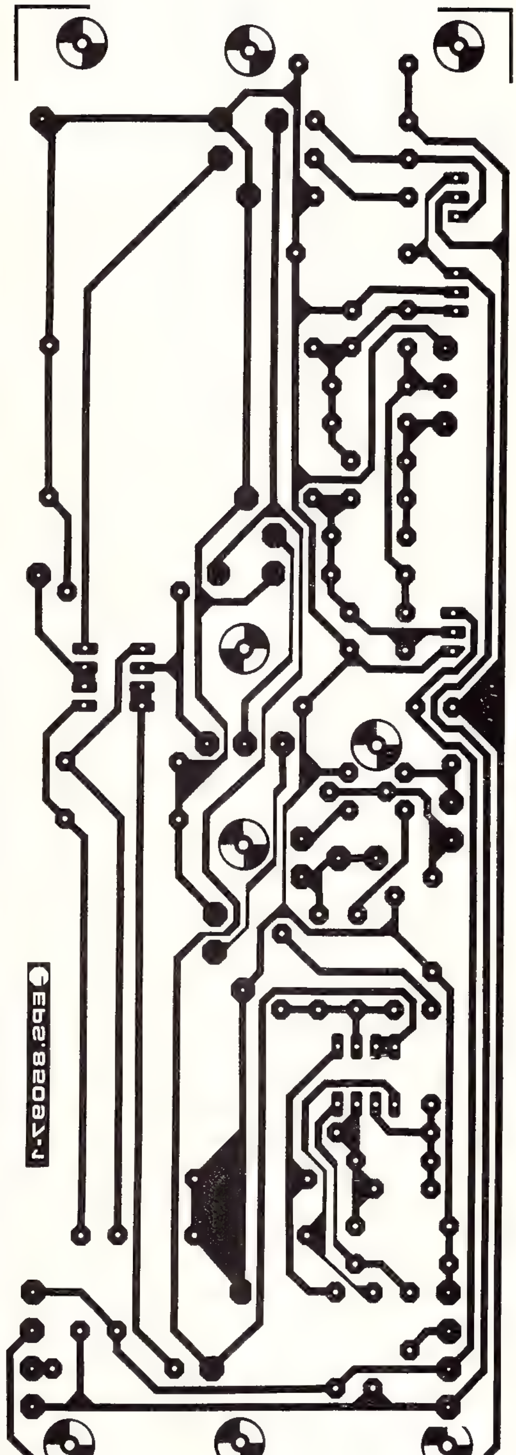

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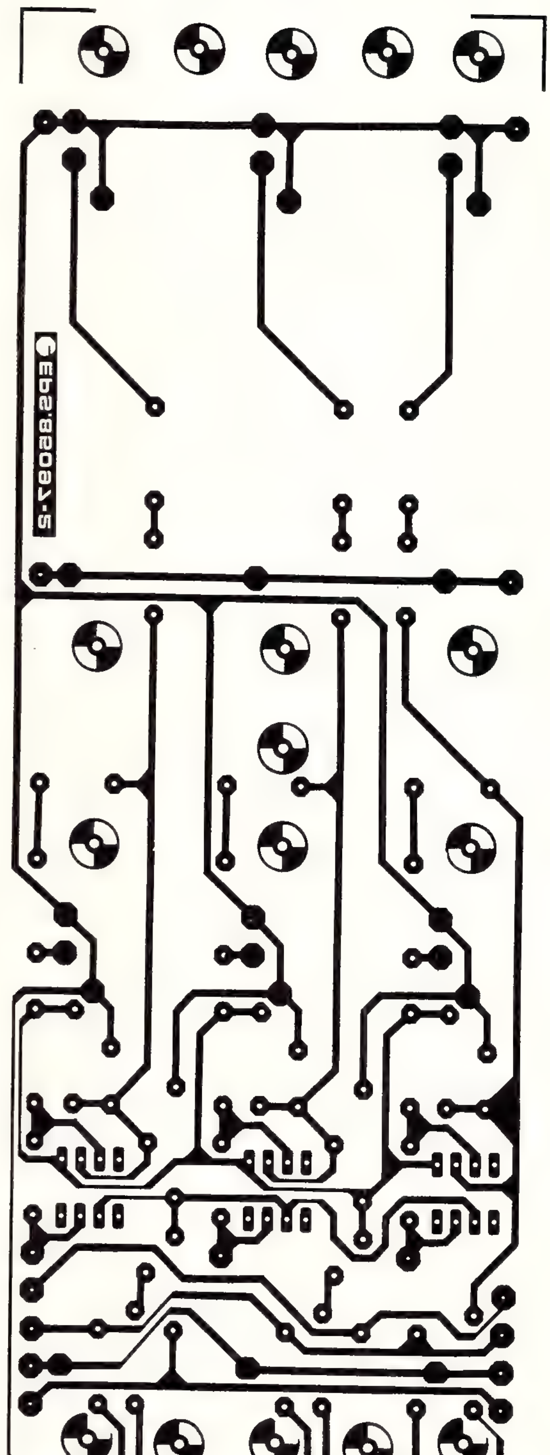

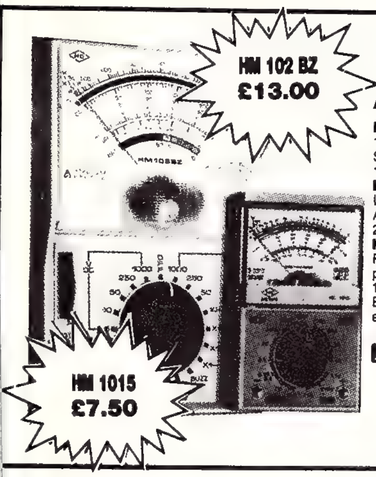

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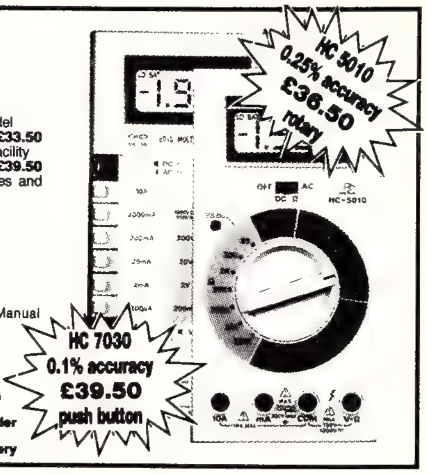

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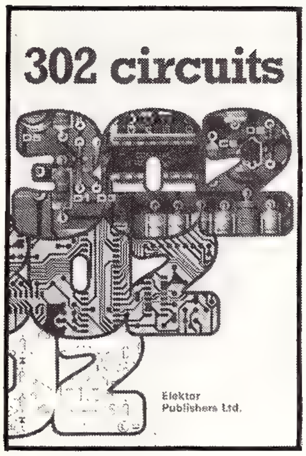

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high-resolution colour graphics card - 2

the second in a series of articles describing a 512×512 or 512×256 pixel, black & white or colour, graphics card

by P Lavigne & D Meyer

A graphics display processor ⟨GDP⟩ such as the Thomson Types EF9365, EF9366, or EF9367 is designed to generate the video signal and the sync(hronization) signals. To the user, it acts as an intelligent graphics screen controller with a picture scan that can be programmed via an eight-bit microprocessor. Apart from these functions, it also contains circuits for writing to the screen memory: a vector generator and a character generator. These enable writing on the screen at high speed (for instance, a 512 pixel diagonal in less than 700 μs) so that the host microprocessor is relieved of these basic tasks.

The GDP has virtually no effect on the memory addressable by the microprocessor since it occupies only sixteen addresses: with the addition of external registers such as scroll, colour, and page switching, to no more than twenty addresses. A further advantage is that the host and GDP memories have completely different cycles. This does not cause problems when the microprocessor bus has to communicate direct with the screen memory since a special timing procedure prevents the disruption of the display.

The GDP is programmed by 11 internal registers occupying 16 successive addresses. These registers may also be changed by the character or vector generators while a command is being executed. This means that the user does not have to input a new command or change the contents of any of these registers before the previous instruction has been executed. The GDP's internal structure is illustrated in Fig. 4, while the pin designations for the Types EF9365, EF9366 and EF9367 are shown in Fig. 5. Only the functions and signals of the GDP that are relevant to the present article will be discussed.

Power supply & logic levels

A 5 V power supply is used, all inputs and outputs of which are TTL compatible. A high input level lies between 2.2 V and 5.0 V; a low level between 0 V and 0.8 V. Nominal current consumption is about 80 mA.

Microprocessor bus

The input/output ⟨I/O⟩ buffers on lines $D_0 \ldots D_7$ (pins 33...26) are enabled by $\overline{E}$; the direction is controlled by $R/\overline{W}$. Writing is indicated by a low logic level. The $\overline{E}$ signal has the dual tasks of synchronizing and enabling communication via the bus. The address of the register that is to be accessed is applied to lines $A_0 \ldots A_3$ (pins 9...12). The $\overline{IRQ}$ signal at pin 13 provides an interrupt request and is programmed by the CTRL1 register.

4

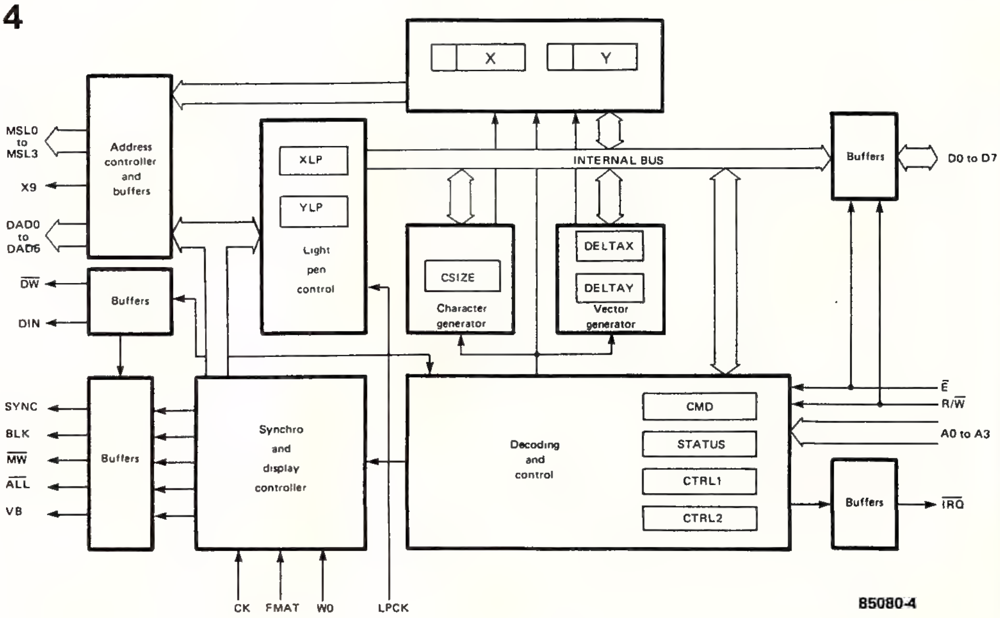


Figure 4. Internal organization of the graphics display processor.

Light pen

If a light pen is used, the $\overline{\text{WHITE}}$ on pin 24 forces the video signal to become white. The signal provided by the light pen is applied to the LPCK ⟨light pen clock⟩ input on pin 21. The GDP then loads the current address into registers XLP and YLP.

Sync(hronization) signals

The line (horizontal) and field sync pulses (625 lines; 50 Hz) for the video monitor are provided by the SYNC signal on pin 34. All signals outside the display window are suppressed by the blanking signal ⟨BLK⟩ on pin 25. The vertical blanking ⟨VB⟩ signal on pin 16 is high during the field retrace.

Setting the parameters

The format ⟨FMAT⟩ input must be connected as shown.

FMAT	vertical resolution	
processor	256	512
EF9365	0	1
EF9366	1	—
EF9367	0	1

When the write only ⟨WO⟩ signal on pin 23 is high, there is no display and the memories are not refreshed. None the less, the vector and character generators function as normal.

Clock and screen memory addressing

The general clock ⟨CK⟩ is input at pin 1; all internal signals are changed at the trailing edge of the clock pulse. It is used for multiplexing video memory addresses $DAD_0 \ldots DAD_6$. When CK is low, the addresses of the row address strobe ⟨RAS⟩ ines are output on DAD lines $A_0 \ldots A_6$. The frequency of the clock is the same as hat of the sync pulses.
The display and refresh addresses appear on pins $DAD_0 \ldots DAD_6$ in two steps; the maximum memory space is 16 K. Memory select lines $MSL_0 \ldots MSL_3$ provide signals that define a written pixel; they are needed to access a single of the eight bits addressed by $DAD_0 \ldots DAD_6$.

A low level on the $\overline{\text{ALL}}$ line at pin 22 indicates that the operation in progress concerns all the memory banks (i.e., collective access). This is, of course, different to the bit-by-bit access provided by the MSL signals. Collective access is normally used for display, refreshing, or erasing. The data written to the memory consists of a single bit output by the display in ⟨DIN⟩ line on pin 15. If this pin is high, it represents a dark pixel on the screen. In a monochrome application, DIN could be the direct data input to the memories. For a colour application, however, DIN must be combined with the RGB inputs. Writing to the screen memory is enabled by the display write ⟨$\overline{\text{DW}}$⟩ signal on pin 14.
A low memory free ⟨$\overline{\text{MFREE}}$⟩ signal at pin 19 indicates that the bit addressed by the microprocessor via a special instruction is available at the output of the appropriate memory. This signal, therefore, enables communication with the memory address indicated by registers X and Y — which can be programmed by the user — without disrupting the display. It always responds to an external request for access to the screen memory.
All these signals will be met again later in this article.

Screen memory

If a picture consists of VH pixels, and each pixel can have 2^b states — where V is the number of usable lines; H is the number of bits in a horizontal line; and b is the number of primary colours — the screen memory must contain VHb bits. Note that a pixel may comprise several bits: usually three, sometimes four. If H is large, the frequency of the video signal is greater than the maximum frequency for reading the memories. When, for instance, $H=512$ and the normal line scanning frequency of 15.625 kHz is used, pixels appear at 70 ns intervals. A horizontal line is divided into h bytes of n successive bits that are read simultaneously onto the screen and converted by an autonomous (= dot clock + shift register) circuit into the video signal. The memory is, therefore, accessed h times per line. Each

5

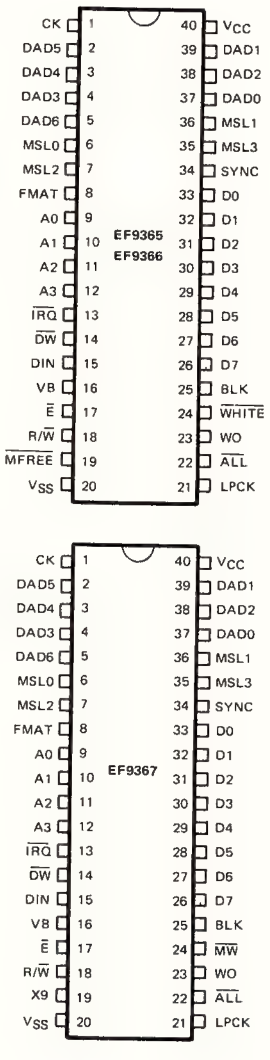


Figure 5. Pin-outs of the Thomson-EFCIS graphics display processors.

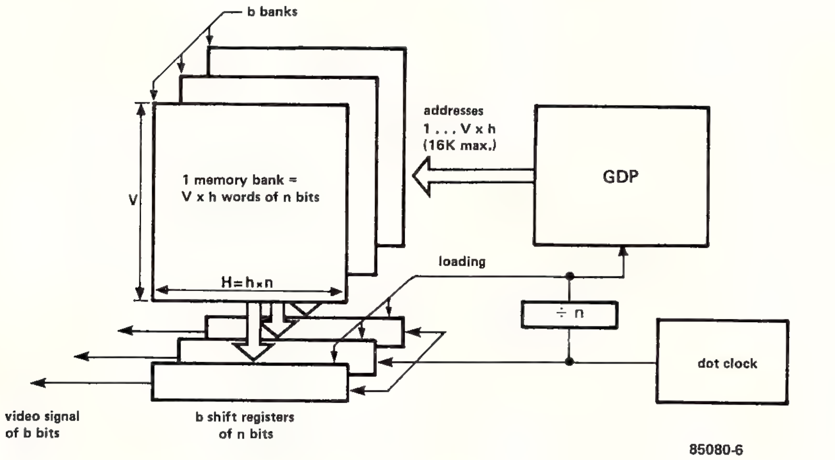


Figure 6. Schematic representation of the screen memory.

7

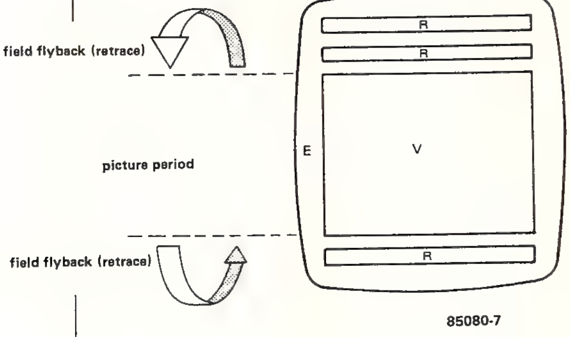


Figure 7. Outside the display window, writing can take place at all times, except during the three refresh cycles shown.

access loads every one of b registers with n bits. The memory then contains Vhb words of n bits as shown in Fig. 6. In the present circuit, the following formats are possible:

b	theoretically unlimited; in practice 0...4 (RGB+I)
n	8
H	512
V	256 or 512

8

Figure 8. Correlation between the display and write addresses.

9366/9367 (512 × 256)

h5	h4	h3	h2	h1	h0	V7	V6	V5	V4	V3	V2	V1	V0
X8	X7	X6	X5	X4	X3	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0

9367 (512 × 512)

h5	h4	h3	h2	h1	h0	V7	V6	V5	V4	V3	V2	V1	V0	t
X8	X7	X6	X5	X4	X3	Y8	Y7	Y6	Y5	Y4	Y3	Y2	Y1	Y0

9a

Figure 9. Illustrating the discrimination between collective and pixel-by-pixel access.

9366/9367 (512 × 256)

		MSL				DAD						
$\overline{ALL}$	CK	0	1	2	3	0	1	2	3	4	5	6
0	0	X	X	X	1	h5	h4	h3	h2	h1	h0	V0
0	1	X	X	X	1	V7	V6	V5	V4	V3	V2	V1

b

X = don't care

		MSL				DAD						
ALL	CK	0	1	2	3	0	1	2	3	4	5	6
1	0	X0	X1	X2	1	X8	X7	X6	X5	X4	X3	Y0
1	1	X0	X1	X2	1	Y7	Y6	Y5	Y4	Y3	Y2	Y1

c

9367 (512 × 512)

		MSL				DAD						
$\overline{ALL}$	CK	0	1	2	3	0	1	2	3	4	5	6
0	0	X0	X1	X2	V1	h5	h4	h3	h2	h1	h0	V0
0	1					V7	V6	V5	V4	V3	V2	t
1	0	X0	X1	X2	Y2	X8	X7	X6	X5	X4	X3	Y1
1	1					Y8	Y7	Y6	Y5	Y4	Y3	Y0

Apart from the $DAD_0...DAD_6$ signals, used to address the h words of n bits, there are also MSL lines to select a pixel of b bits within the addressed word. Since $n=8$, there are three MSL lines: $MSL_0...MSL_2$. The MSL_3 line, used in the interlaced scanning mode ($V=512$), enables distinction to be made between odd and even numbered frames. It controls the A_7 line of the Type 4164 ICs.

Refresh and display

As stated earlier, the GDP effects three fundamentally different operations on the memory: display ⟨D⟩ which arranges the contents of the memory before making it visible on the screen; writing ⟨W⟩; and refreshing ⟨R⟩. Outside the window, where the memory is used only for display and refreshing, writing can take place at all times, except during three refresh cycles as shown in Figure 7. The nature of the operation is indicated by the state of the BLK and $\overline{ALL}$ signals as shown.

BLK	$\overline{ALL}$	
0	0	D
1	1	W
1	0	R

It will be seen later that there are exceptions to these situations.

Relation between DAD & MSL outputs and *x*, *y* coordinates

Registers X and Y are twelve-bit read and write registers that contain the coordinates of the next pixel to be written onto the screen memory. They have nothing whatever to do with the video scanning functions but form the write address for the memory. With 2 × 12 bits, this address covers a space of 4096 × 4096 (=2^{24}) pixels. Only the least significant bits ⟨LSBs⟩ are needed because the actually memorized image is of lower definition. None the less, the most significant bist ⟨MSBs⟩ are used, since they enable an image to be generated that is much larger than the actual size of the screen.
The nine least significant bits of coordinates x and y are called $X_0...X_8$ and $Y_0...Y_8$ respectively.
The internal counters generating the screen memory addresses are organized into:

- six line address bits ($h=64$ words of n bits): h_0; h_1; h_2; h_3; h_4; h_5

- nine field address bits (V=256 or V=512): t; V_0; V_1; V_2; V_3; V_4; V_5; V_6; V_7

where t is the LSB that indicates the parity of the frames if V=512; when V=256, t does not exist.
The correlation between the display address (bits h, V, and t) and the write address (bits X and Y) is given in Figure 8. The Type EF9365 processor is purposely not included in this figure, although it can

support either interlaced or sequential scanning, because it imposes a field resolution that is equal to the line resolution. The EF9366 provides sequential scanning only (V=256). The EF9367 can handle either 512×256 or 512×512 pixels. In the sequential scanning mode, the EF9366 is interchangeable with the EF9367.

Everything dealt with so far has been fairly straightforward, but the procedure for assigning the address bits for display and writing to the processor's output pins ⟨DAD and MSL⟩ is rather more complicated. So as to simplify matters a little, Fig. 9 discriminates between collective and pixel-by-pixel access. The sequential scanning mode, shared by the EF9366 and EF9367, is, as shown in Fig. 9a, a collective access mode since $\overline{\text{ALL}}=0$. During the first half of the access cycle, when CK=0, and the system is in the display mode, lines $\text{DAD}_0 \ldots \text{DAD}_6$ output horizontal address bits $\text{DAD}_0 \ldots \text{DAD}_5$ as well as least significant field address bit V_0 on DAD_6. This is important for the operation of the scroll circuit.

During the second half of the access cycle, still in the display mode, the DAD lines provide the remainder of the field address bits. **Note that all through this cycle, the logic levels on the MSL lines are irrelevant because operation is in the collective access mode.**

Pixel-by-pixel access is illustrated in Fig. 9b. The three LSBs of register X appear, therefore, on the MSL lines for selecting one of the eight bits in the word addressed by the DAD lines. Here again, the least significant vertical address bit is found in the first half of the access cycle along with the line address bits. This time, the MSL lines are used to address a single bit in the word addressed by the two bursts of signal issued by the DAD pins.

Figure 9c shows the two memory access modes grouped together for an EF9367 in nterlaced mode (collective: $\overline{\text{ALL}}=0$; pixel-by-pixel: $\overline{\text{ALL}}=1$). The manner of dealing without output X_9 of the EF9367 will be discussed later.

n the Type EF9366, the memory is efreshed every two display lines (128 efresh cycles), whereas in the EF9367, his refresh occurs every four lines (256 efresh cycles).

Dynamic random access memory

A knowledge of the basic function of a ynamic random access memory ⟨RAM⟩ is ssential for an understanding of the operation of the present circuit and for seeing ne importance of rigid timing of all ignals. Each of the Type 4164 RAMs contains 2^{16} (=65536=64 K) one-bit memory ells. The contents of each of these cells ust be refreshed once every two illiseconds to prevent their corruption. A efresh is effected simply by a read peration.

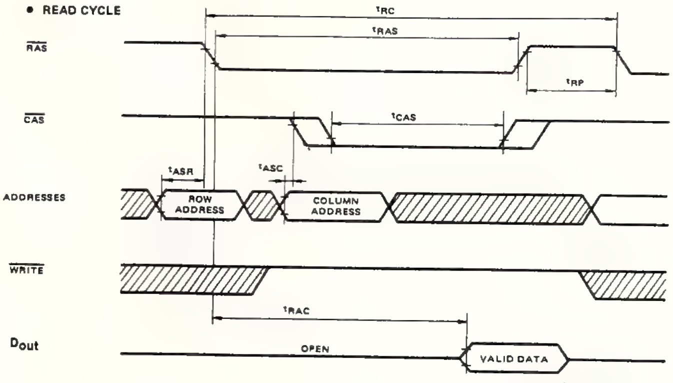
n principle, sixteen separate address nes are needed to access each of the 5536 cells. Fortunately, the 64 K bits are ranged in a matrix with multiplexed addressing. This means that the address of the matrix line ⟨row address⟩ on which the cell to be accessed is situated is specified first and then — on the same address line — the address of the column on which the cell is located. In this way, only eight address lines and two extra pins for enable signals are needed. These latter signals indicate when the addresses applied to the RAM are row addresses and when they are column addresses. They are called $\overline{\text{RAS}}$ (row address strobe = line address enable pulse) and $\overline{\text{CAS}}$ (column address strobe = column address enable pulse) respectively. The bar above the signals indicates *inverse logic*, i.e., the signals are active when their logic level is low.

Not all 65536 cells need to be accessed individually for a refresh: a collective refresh can be used in which only the 256 matrix lines are addressed. Manufacturers of integrated circuits endeavour to keep the 64 K RAM circuits compatible with their 16 K predecessors, which have only 2^{14} (128×128=16384) cells, with the result that some 64 K memory chips need a refresh of only 128 instead of 256 lines. The relevant data sheet indicates this by the note "128 refresh cycles/2 ms", while the diagram of the refresh signals shows "A_7: don't care".

The timing of the $\overline{\text{RAS}}$ and $\overline{\text{CAS}}$ signals, and the corresponding address signals, is important. Timing diagrams are shown in Figures 10 and 11.

During a read or a write operation, the first signal to become active is $\overline{\text{RAS}}$ (pin 4 of a Type 4164). The RAM uses the eight logic levels present on pins $A_0 \ldots A_7$ at that moment to address the relevant matrix line. A short time later, while $\overline{\text{RAS}}$ remains active, $\overline{\text{CAS}}$ also becomes active. The IC then sees the levels on address lines $A_0 \ldots A_7$ as the column address, but — in terms of the 64 K memory — these are really address lines $A_8 \ldots A_{15}$. It is, therefore, necessary that the bits of address lines $A_8 \ldots A_{15}$ are applied to pins $A_0 \ldots A_7$ after $\overline{\text{RAS}}$ but before $\overline{\text{CAS}}$. Note that with dynamic RAMs address signals $A_0 \ldots A_7$ need not be present before the $\overline{\text{RAS}}$ or $\overline{\text{CAS}}$ pulses, because t_{ASR} and t_{ASC} may be 0!

10



85080-10

Figure 10. Timing diagram of the read cycle.

11

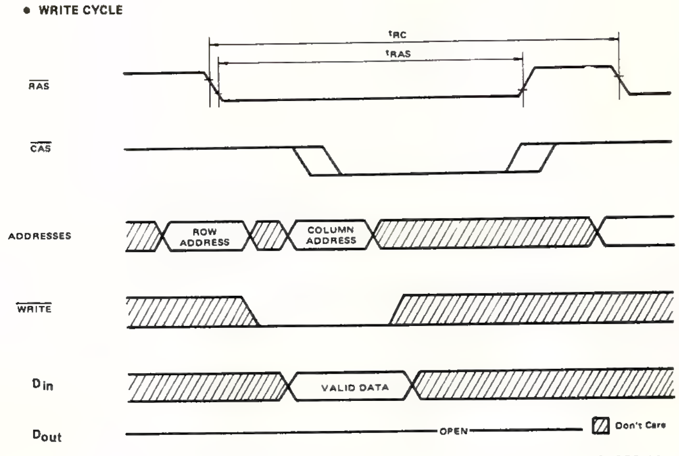


Figure 11. Timing diagram of the write cycle.

If the above were a read operation, the logic level of the addressed bit would appear on the D_{out} pin of the RAM a few nanoseconds after the address signals had been strobed. If the memory were written to, the $\overline{WRITE}$ line (pin 3 of a Type 4164) would be activated and the correct logic level applied to the D_{in} pin shortly before $\overline{CAS}$ became active.

For a refresh, the address line must be selected and $\overline{RAS}$ activated, when not only the timing of the refresh but also that of the $\overline{RAS}$ signal is important. Before the $\overline{RAS}$ signal can become active, and remain low during t_{RAS}, it must have been high for at least t_{RP}, i.e., the pre-charge time needed by the IC.

Read-modify-write mode

One unusual mode of operation is the read-modify-write (RMW) mode, in which a given address is read from, and written to, in the same access cycle.

In Part 1 it was shown that, depending on the logic levels, six colours plus black and white can be produced, and further that a bright pixel has a low logic level, while a dark pixel has a high logic level.

Every time an object is moved across a design (base) on the screen, part of that design is defaced. When the movement ceases, all defaced parts of the base have to be reconstructed. This complex operation is carried out by an eight-input NAND, two AND, and two OR gates as shown in Figure 12.

Writing to the screen is only possible when the $\overline{WRITE}$ signal has been enabled and the logic level of the data to be written (D_{in}) has been defined. In the RMW mode, this level is defined not only by the wanted result (pixel bright or dark), but also by the previous state of the element. If the pixel was bright before, it will be quenched; if it was dark, it will be bright. When the pixel appears on the screen, it is examined. If the screen is dark, the pixel appears bright, and if it is light, the element is dark. The screen is returned to its previous state by redrawing all relevant pixels at the same position, bur with the logic level reversed.

12

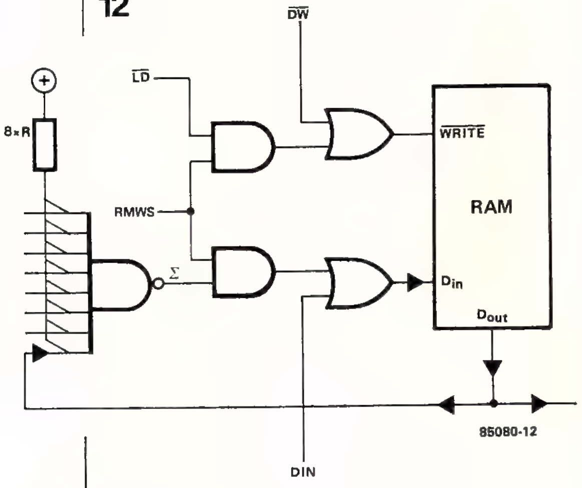


Figure 12. RMW selection in the monochrome mode is carried out by this array of gates.

To make an object appear on the screen, the state of the relevant pixels is reversed. To revert to the original state, this operation is carried out a second time. The successive inversions negate one another. This could be considered as an exclusive OR (XOR) function between the pen and the paper: if the paper is white, the pen is black; and where the paper is black, the pen is white.

An RMW cycle starts with accessing the video memory for a read and finishes with a write. Between these actions, the addressed bit is modified.

The eight-input NAND gate returns the addressed bit with its state inverted, while all other bits are forced high. When the read-modify-write-select (RMWS) line is high, it indicates that the RMW mode is active. If the line is low, the level on the DIN pin, which is provided by the GDP, is loaded into the screen memory when the data write (DW) pulse appears. The state of the screen is not taken into account then, since that is only of importance in the RMW mode. When that mode is selected, the combination of RMWS and load ($\overline{LD}$) signals prevent the $\overline{DW}$ signal from reading the bit output by the NAND gate into the memory: otherwise, this bit would be inverted by the NAND gate and returned to the relevant RAM via DIN.

If a bright pixel is required, the DIN line should be low; the corresponding logic level is loaded via D_{in}. If, on the other hand, the element is to be dark, the DIN line should be high, with the result that the corresponding bit in the memory is and remains high.

Operation in the RMW mode can be disrupted if the delay inherent in the NAND, AND and OR gates does not corrupt the timing of the RAM. The shorter the t_{RAC} signal, the more time there is for the RMW logic to change the data and input this to D_{in} before the $\overline{WRITE}$ pulse arrives. t_{RAC} is the time between the start of $\overline{RAS}$ and the appearance of data on D_{out}, called "access time" on the relevant data sheet. In theory, t_{RAC} should not exceed 150 ns (NEC4164-3; Hitachi 4864-2;

Toshiba 4164-3; OKI 3764-15; MOSTEK 4564-15; and others), but practical experience has shown that the RMW circuit will work quite satisfactorily with access times of up to 300 ns.

If colour is included, the RMW circuit is as illustrated in Figure 13, in which the gates specific to this mode are shown shaded. One of the seven gates is shared with another function, which will be reverted to in due course. The two extra gates increase the efficiency of the whole and do not increase the delay when a data bit travels from the output of a memory to its input.

The circuit remains the same as for monochrome, except that some colour selection signals are added. These consist of red select ⟨RS⟩; green select ⟨GS⟩; blue select ⟨BS⟩; red write select ⟨RWS⟩; green write select ⟨GWS⟩; and blue write select ⟨$\overline{BWS}$⟩. Unlike DIN and $\overline{DW}$, which are provided by the GDP, these signals are controlled by the user via the colour register. If one of RS, GS, or BS is high, the addressed pixel will be dark as far as the corresponding colour is concerned, provided the RWS, GWS, or BWS line is low to allow the memory to be accessed. If an RS, GS, or BS signal is low, and the associated RWS, GWS, or BWS signal is also low, the corresponding pixel will have the relevant colour. All possible combinations with and without RMW (in monochrome) are listed in Table 2.

13

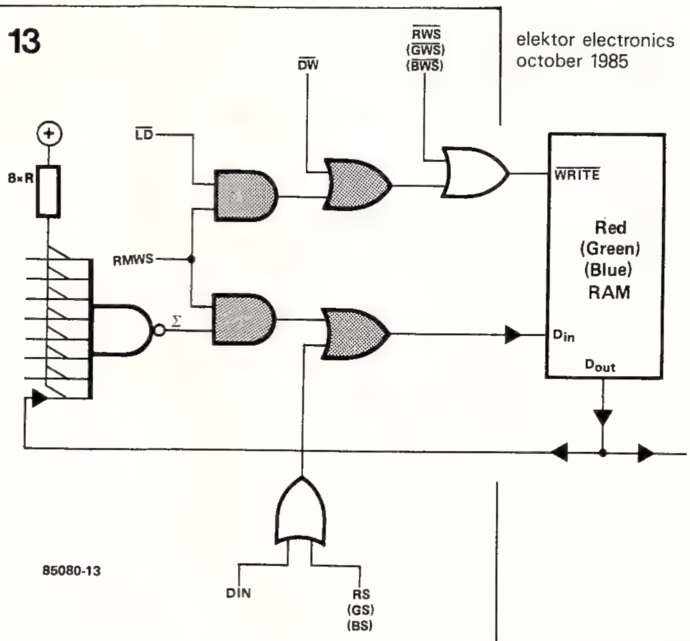


Figure 13. RMW selection in the colour mode is carried out by this combination of gates.

Table 2.

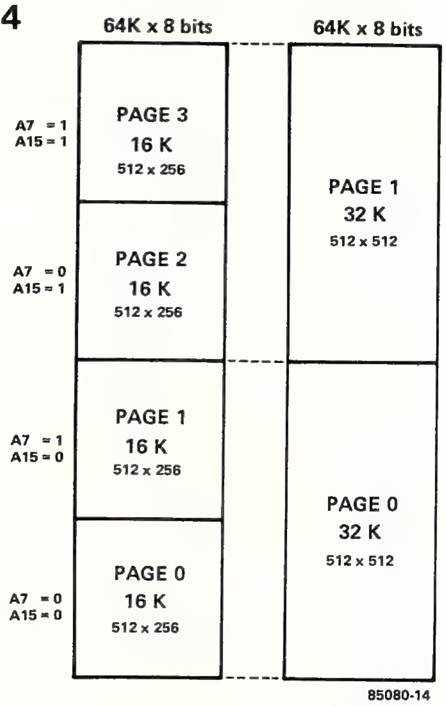
($\overline{DW}$ = 0)			
RMWS	$\overline{D_{out}}$ = Σ	DIN	pixel
0	X	1	dark
0	X	0	bright
1	0	0	bright (was dark)
1	0	1	dark (was dark)
1	1	X	dark (was bright)

Memory capacity & image resolution

If an image has a horizontal resolution (the number of pixels on a line scanned in the display window) of 512, and a vertical resolution (number of lines scanned) of 256, the display window contains a total of 131 072 pixels, so that 16 K of memory is needed per colour. An image with a resolution of 512×512 pixels needs 32 K of memory. Note that in the latter case there are, in fact, two interlaced images, each requiring 16 K. Doubling the vertical resolution increases the quality of the image, but also shows up an instability of the interlaced image, which is quite noticeable on static displays like those produced by the present graphics card. It is more visible on some monitors than on others.

Whatever resolution is selected, no more than a quarter to a half of the 64 K memory is needed. The remainder cannot be used for colour, but it need not go to waste, since it is useful for storing several totally independent images that can quite simply — and immediately — be displayed on the screen. In one case, there are four pages available, numbered 0. . .3, depending on the logic levels of multiplexed address signals A_7 and A_{15}; in the other case there are two pages, numbered 0 and 1 as shown in Figure 14.

14



The use of A_7 and A_{15} to switch pages introduces a limitation, namely that the type of RAM used should not require A_7 and A_{15} to be refreshed; this prohibits, for instance, the use of the Siemens HYB4164 on the graphics card.

Part 3 will appear in our November 1985 issue.

new products

YIG tuned oscillators

Yttrium Iron Garnet (YIG) tuned oscillators covering the frequency range of 1...18 GHz are available from Pascal Electronics Ltd.
Manufactured by the French company Giga Modules, these oscillators provide high spectral purity signals and low phase noise, due to the high selectivity of the resonant YIG crystal. They have good linearity and are available with output power options in the range 10...20 dBm.

YIG oscillators are used in many microwave applications, and are particularly suitable for microwave sweep generators. They can also be used as local oscillators in wide-band receivers and telecommunication systems.

Pascal Electronics Ltd
Saxon House
Downside
Sunbury on Thames TW16 6RY
Telephone: (01) 979 0123
Telex: 8814536 (3315/11F)

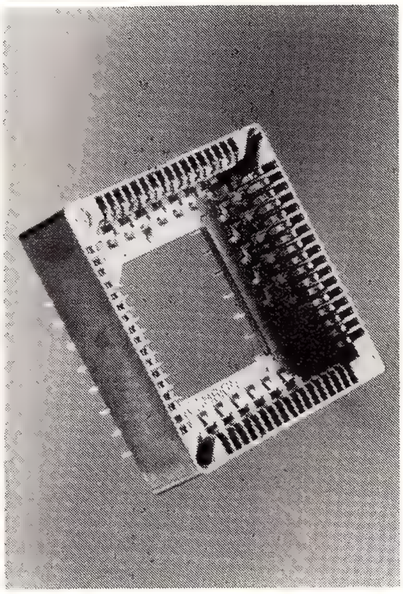
Sixty connectors from thirteen parts

The Suhner Electronics 7/16 Combination System allows the production of sixty different cable connectors from only thirteen basic parts. This efficient use of individual components provides types for almost all coaxial cables for 2.95 mm, 4.7 mm, or 7.25 mm dielectric diameter.
These connectors have an impedance of 50 ohms, operate to at least 4 GHz, and are suitable for medium to high power applications in the VHF and UHF bands. They are of a robust mechanical design and the heads can be mounted to form straight or right-angled connectors.

Suhner Electronics Ltd
Telford Road
Bicester
Oxfordshire OX6 0LA
Telephone: (08 692) 44676
Telex: 837615 (3315/10F)

Sixty-eight position chip carrier socket

The Electronic Connector Division of Midland-Ross have just launched the new 68-position Cambion 709-2000 series Chip Carrier Socket designed to accept Jedec leaded plastic chips with surface mount J leads on 1.27 mm centres, converted to a straight leaded or legged 2.54×2.54 mm grid, for through board mount. The series will be expanded by models with 32, 44, 52, 84, or 124 positions later this year.

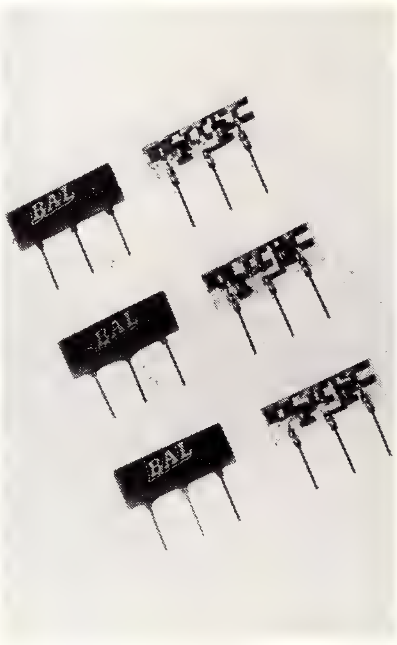


These sockets have integral boards stand-offs that allow for heat dissipation, and extractor tool slots to facilitate chip removal. Compatible with the most advanced VLSI packaging systems, the socket contacts are specially designed to provide tactile feedback that allows the plastic chip to snap into place for a secure and reliable connection in high-density packaging.
The socket contacts are manufactured from tin plated beryllium copper, with the carrier body moulded from glass reinforced PPS (UL 94 V-O rated) for stability through operating temperatures of up to 125°C.

Midland-Ross Limited
Electronic Connector Division
Castleton
Sheffield S30 2WR
Telephone: (0433) 20831
Telex: 54444 (3315/12F)

SIL Gaussian filters

By adopting a single-in-line format for their new range of Gaussian filters, BAL Components have reduced their occupancy of PCB space by sixty per cent. None the less, these smaller components have improved tolerances compared with previous designs common in the industry.
The filters range from 0.5 MHz to 5 MHz in impedances of 75 ohms and 510 ohms. They are intended for pulse shaping and bandwidth limitation and, therefore, produce no overshoot or undershoot when subjected to a step response. This same quality lends them to the removal of unwanted pulse overshoot, undershoot, ringing, and noise distortions.



Dimensions are 0.9 in by 0.2 in (22 mm by 5 mm) over the PCB, and 0.35 in (9 mm) high. Pin separation is 0.3 in (7.6 mm).

BAL Components Ltd
Bermuda Road
Nuneaton
Warwickshire CV10 7QF
Telephone: (01) 836 2205 (3315/8F)

new products

Electronic kits for the car enthusiast

A number of easy-to-assemble kits for enhancing your car are now available from Electronic & Computer Workshop Limited. The kits contain all the necessary components for successful, trouble-free assembly, including a high-quality PCB, and full, step-by-step instructions and application notes.

The K2599 wiper delay kit — price £12.82 — provides a three-step intermittent wiper timer, selected by a rotary switch. This unit can be inserted into virtually any existing wiper control circuit.

The K2598 kit builds a 10...30 watt, mono or stereo amplifier, designed to operate from 12 V DC. The unit is compatible with standard car radio/cassette player voltage levels as defined in DIN45500, and is fitted with thermal and short-circuit protection. This kit retails at £16.94.

The benefits of easy starting, efficient fuel burning, and even firing provided by transistorized ignition can be achieved with kit K2543 — price £12.48.

All prices stated include p&p and VAT.

Electronic & Computer Workshop Ltd
171 Broomfield Road
Chelmsford
Essex CM1 1RY
Telephone: (0245) 262149 (3315/7)

Surface-mounting solder creams

Indium Corporation of America has introduced a surface-mounting solder cream kit, which features three alloys chosen for their popularity and usefulness in the surface mounting of electronic devices.

Designed specifically for the production, design, or manufacturing engineer working with surface-mount technology, the kit is one of six available to engineers who wish to explore the properties and potential of Indalloy^{R} solders. The other kits are: General Purpose Kit; Special Joining/Bonding Kit; Microelectronics Wire Kit; Microelectronics Cream Kit; and the Multi-purpose Cream Kit. Indium has also released a Surface Mounting Technical Bulletin which provides more information on solder creams for surface-mounting applications.

Indium Corporation of America is a leading supplier of special-purpose solders and alloys for the worldwide electronics industry.

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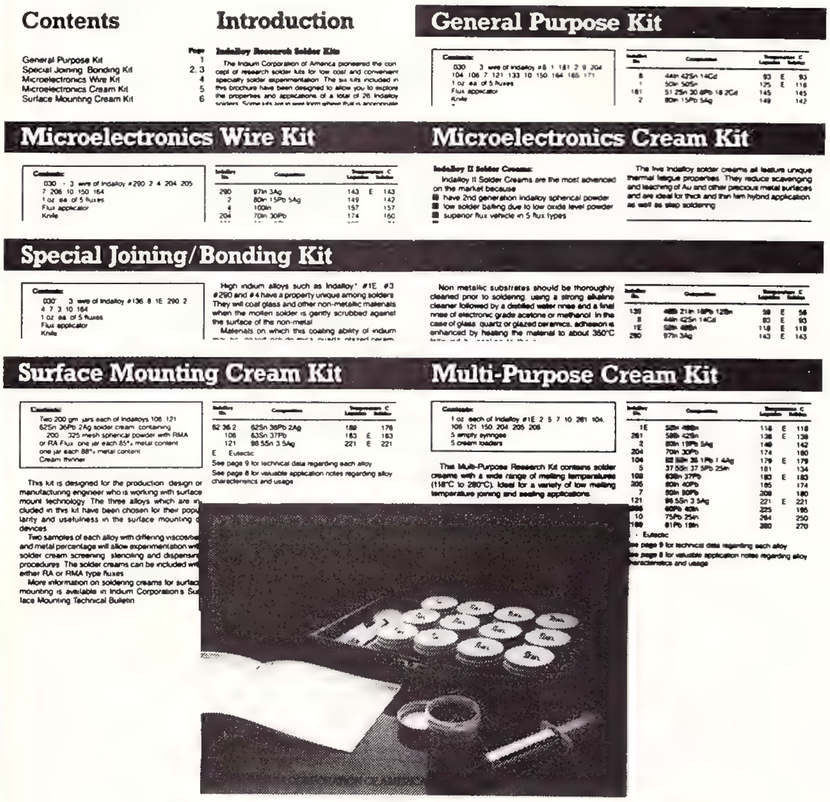
Telephone: (08) 742 0150
Telex: 17572 (3315/5F)



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Introduction

Indalloy Research Solder Kits

The Indium Corporation of America pioneered the concept of research solder kits for low cost and convenient specialty solder experimentation. The six kits included in this brochure have been designed to allow you to explore the properties and applications of a total of 26 Indalloy solders. Some kits are in wire form where that is appropriate

General Purpose Kit

Contents:
030 · 3 wire of Indalloy #8 1 181 2 9 204 104 106 7 121 133 10 150 164 165 171
1 oz. ea. of 5 fluxes
Flux applicator
Knife

Indalloy No.	Composition	Temperature C Liquidus		Solidus
8	44In 42Sn 14Cd	93	E	93
1	50In 50Sn	125	E	118
181	51.2Sn 30.6Pb 18.2Cd	145		145
2	80In 15Pb 5Ag	149		142

Microelectronics Wire Kit

Contents:
030 · 3 wire of Indalloy #290 2 4 204 205 7 206 10 150 164
1 oz. ea. of 5 fluxes
Flux applicator
Knife

Indalloy No.	Composition	Temperature C Liquidus		Solidus
290	97In 3Ag	143	E	143
2	80In 15Pb 5Ag	149		142
4	100In	157		157
204	70In 30Pb	174		160

Microelectronics Cream Kit

Indalloy II Solder Creams:
Indalloy II Solder Creams are the most advanced on the market because
- have 2nd generation Indalloy spherical powder
- low solder balling due to low oxide level powder
- superior flux vehicle in 5 flux types

The five Indalloy solder creams all feature unique thermal fatigue properties. They reduce scavenging and leaching of Au and other precious metal surfaces and are ideal for thick and thin film hybrid application as well as step soldering

Special Joining/Bonding Kit

Contents:
030 · 3 wire of Indalloy #136 8 1E 290 2 4 7 3 10 164
1 oz. ea. of 5 fluxes
Flux applicator
Knife

High indium alloys such as Indalloy® #1E, #3, #290 and #4 have a property unique among solders. They will coat glass and other non-metallic materials when the molten solder is gently scrubbed against the surface of the non-metal.
Materials on which this coating ability of indium

Non metallic substrates should be thoroughly cleaned prior to soldering, using a strong alkaline cleaner followed by a distilled water rinse and a final rinse of electronic grade acetone or methanol. In the case of glass, quartz or glazed ceramics, adhesion is enhanced by heating the material to about 350°C

Indalloy No.	Composition	Temperature C Liquidus		Solidus
136	49Bi 21In 18Pb 12Sn	58	E	58
8	44In 42Sn 14Cd	93	E	93
1E	52In 48Sn	118	E	118
290	97In 3Ag	143	E	143

Surface Mounting Cream Kit

Contents:
Two 200 gm. jars each of Indalloys 106, 121, 62Sn 36Pb 2Ag solder cream, containing 200 · 325 mesh spherical powder with RMA or RA Flux: one jar each 85% metal content, one jar each 88% metal content
Cream thinner

Indalloy No.	Composition	Temperature C Liquidus		Solidus
62 36 2	62Sn 36Pb 2Ag	189		179
106	63Sn 37Pb	183	E	183
121	96.5Sn 3.5Ag	221	E	221

E Eutectic
See page 9 for technical data regarding each alloy
See page 8 for valuable application notes regarding alloy characteristics and usage

This kit is designed for the production, design or manufacturing engineer who is working with surface mount technology. The three alloys which are included in this kit have been chosen for their popularity and usefulness in the surface mounting of devices.
Two samples of each alloy with differing viscosities and metal percentage will allow experimentation with solder cream screening, stenciling and dispensing procedures. The solder creams can be included with either RA or RMA type fluxes.
More information on soldering creams for surface mounting is available in Indium Corporation's Surface Mounting Technical Bulletin.

Multi-Purpose Cream Kit

Contents:
1 oz. each of Indalloy #1E, 2, 5, 7, 10, 281, 104, 106, 121, 150, 204, 205, 206
5 empty syringes
5 cream loaders

This Multi-Purpose Research Kit contains solder creams with a wide range of melting temperatures (118°C to 280°C). Ideal for a variety of low melting temperature joining and sealing applications.

Indalloy No.	Composition	Temperature C Liquidus		Solidus
1E	52In 48Sn	118	E	118
281	58Bi 42Sn	138	E	138
2	80In 15Pb 5Ag	149		142
204	70In 30Pb	174		160
104	62.5Sn 36.1Pb 1.4Ag	179	E	179
5	37.5Sn 37.5Pb 25In	181		134
106	63Sn 37Pb	183	E	183
205	60In 40Pb	195		174
7	50In 50Pb	209		180
121	96.5Sn 3.5Ag	221	E	221
[illegible]	60Pb 40In	225		195
10	75Pb 25In	264		250
[illegible]	81Pb 19In	280		270

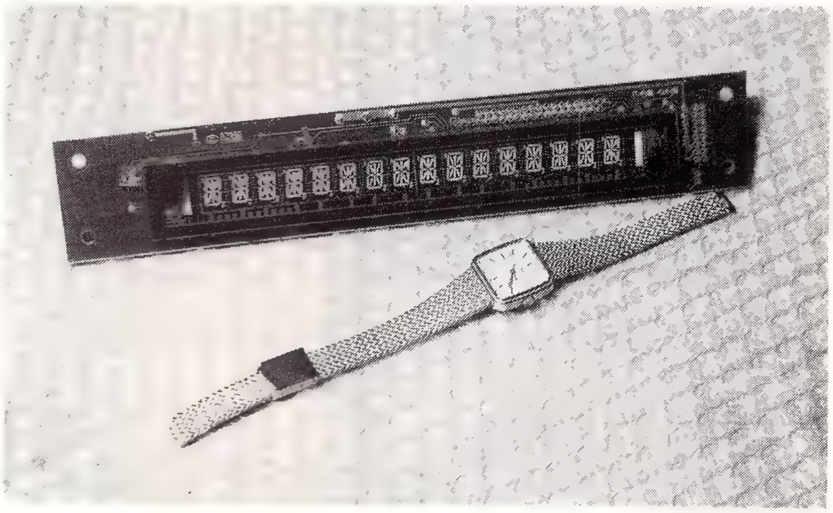
E Eutectic
See page 9 for technical data regarding each alloy
See page 8 for valuable application notes regarding alloy characteristics and usage

Sixteen-character alphanumeric module

Displays manufacturers Pulseview Limited have announced a sixteen-character starburst vacuum fluorescent display module that has been designed specifically for information displays on consumer and industrial electrical equipment. The 9×5 mm characters are displayed in a single row in highly visible green phosphor with thirty-two brightness levels that can be selected by software.

The module, Type 14-05-16.05, uses 14-segment displays to provide a 64-character set with decimal points and commas. The module is housed on a compact single board that contains a display driver, power supply, and control circuits. The single chip controller offers and integral 64×16 bit programmable logic array for segment decoding of the full upper-case ASCII set.

The 14-05-16.05 requires a 5 V DC supply at an average current of 300 μA.



Pulseview Limited
Unit 1 & 2 Suffolk Way
Drayton Road
Abingdon
Oxfordshire OX14 5JY
Telephone: (0235) 34909
Telex: 83428 (3315/13F)

Spelling checker for BBC micro

A spelling checker, the ROM-SPELL, for the BBC Micro is now available from Watford Electronics. This ROM based software is designed to take text from any popular word processor to check the spelling of the words in the text. It is supplied with a 30 000 word dictionary, and has an additional user dictionary in which extra words needed can be entered. Any unknown words encountered during a check are brought to the attention of the user, who then has the choice of correcting the spelling, adding the new word to the user dictionary, or bypassing the word.

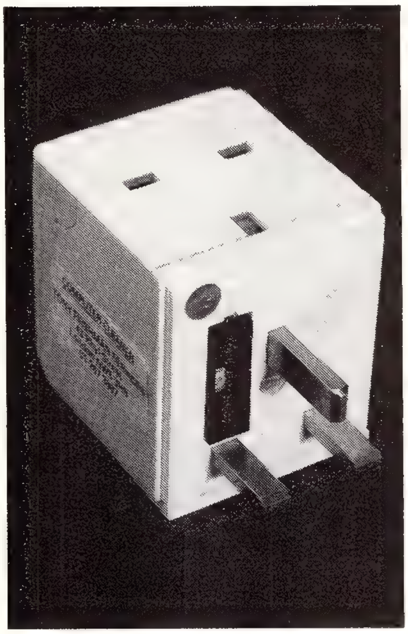
Unfortunately, the many features of ROM-SPELL cannot be given in a short notice, but may be obtained from Watford Electronics. Its price, including a 16 K EPROM and dictionary disc, is £28.75 incl. VAT.

Watford Electronics
250 High Street
Watford WD1 2AN
Telephone: (0923) 37774/40588
Telex: 8956096 (3315/9)

new products

Power supply cleaner

A novel way of preventing noise and spikes superimposed on the mains voltage from reaching your computer is offered by Tony Firshman Services. It is a highly effective mains filter, the *LC* elements of which are contained in a standard 3-pin adapter as shown.



The unit is priced at £14.00. A similar unit based on a 4-way socket and trailing lead is available at £24.00.

Tony Firshman Services
43 Rhyl Street
London NW5 3HB
Telephone: (01) 267 3887 (3315/1F)

Nylon fasteners

A new range of sixty-seven main types of moulded nylon fastener will form the centre piece of PSM Fasteners' stand (820) at Internepcon 85 held from 8...10 October at the Brighton Centre.

The range includes nuts, screws, cable clamps, hole plugs, washers, grommets, drive rivets, threaded rods, and spacers. A special nylon screw with a metal core is also available. This gives the fastener the shear strength of heat-treated steel.

All the fasteners are moulded from nylon 66 which means that they are resistant to corrosion, lightweight, good electrical insulators, and, because they conform to irregular surfaces, reduce vibration loosening.

P.S.M. Fasteners Limited
Longacres
Willenhall
West Midlands WV13 2JS
Telephone: (0902) 66081
Telex: 338565 3315/3F)

New zinc air cell

Duracell Activair has produced a new design of zinc air cell with a capacity of 2.4 Ah: the Type DA1200H. Resembling a 10p coin, it measures 5 mm high and 30 mm diameter, and weighs only 10 grammes.

The DA1200H cell can deliver a maximum continuous current of 140 mA with pulse currents of up to ten times this value depending on the pulse length. As long as the cell is retained in its sealed state, shelf life is not less than 4 years.

Duracell Activair Europe
11 Ash Road
Wrexham Industrial Estate
Wrexham
Clwydd LL13 9UF
Telephone: (0978) 61984
Telex: 617080 (3315/2)

Eight-bit DAC in Surface Mountable Package

Ferranti Electronics is offering its ZN429 monolithic 8-bit DAC in the SO-14 surface mountable small outline package.

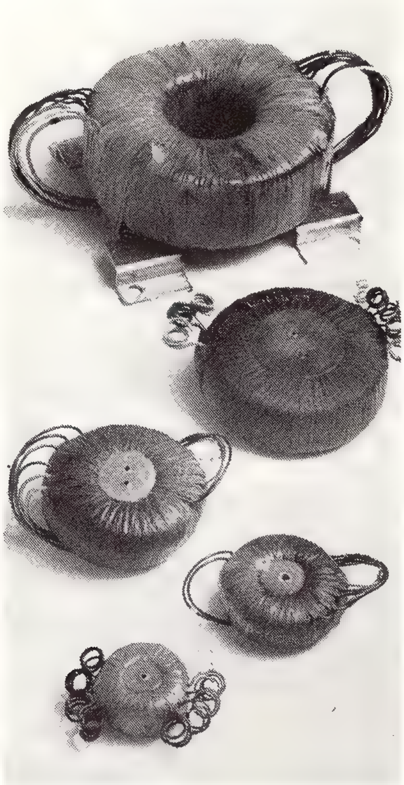
Small outline (SO) packaging offers considerable space saving over conventional DIL packages: SO-14 is based on 1.25 mm centres rather than 2.54 mm and stands only 1.75 mm high as opposed to 7.4 mm. This saving, together with surface mountability, results in smaller, simpler printed-circuit boards which are easier to assemble. It is intended for use where board space is limited and low cost is paramount.

The ZN429D has a typical settling time of 1 μs, a maximum non-linearity of ±0.5 least significant bit, and a temperature coefficient of only 3 ppm/°C. It operates from a single +5 V supply, and has inputs which are compatible with both TTL and CMOS. Monotinicity is guaranteed over the complete operating temperature range.

Ferranti Electronics Limited
Fields New Road
Chadderton
Oldham
Lancashire OL9 8NP
Telephone: (061 624) 0515
Telex: 668038 (3315/4)

Prototype toroidal transformers

Avel-Lindberg has been so successful in its development of a standard range of toroidal transformers, that much of the jobbing aspect of transformer manufacture has been transferred to a Small Quantities and Prototype Department, which can tackle anything, within the limits imposed by winding machine and wire technology, on a 1 to 20 or so upper limit in a batch. Transformers with a practical upper wire gauge limit of 2.00 mm dia. and a lower limit of 0.04 mm dia can be constructed to all specifications, including Def. 05-24.



Designing a complex toroid is a tricky job, which takes time and, despite the use of computers on simple designs to de-skill the operation, there are many factors that a human designer can combine to produce a better than average transformer.

Avel-Lindberg Limited
South Ockendon
Essex RM15 5TD
Telephone: (0708) 853444
Telex: 897106 (3315/6F)

new literature

A practical introduction to the new logic symbols

by Ian Kampel
ISBN 0 408 01461 X
Price £11.50

After years of what at times seemed fruitless discussions, the major technological nations of the West have finally agreed, with immediate effect, to bring their national standards in line with *IEC617-12: Binary Logic Elements*.

Ian Kampel is to be congratulated on seeing at an early stage the importance of this decision and in bringing out in a very short time such a lucid book about a subject that is not all that easy to digest. Although many electronics engineers will wish this book — or rather, its subject matter — to quietly go away, it will not. And all of us engaged in electronics should be glad about that, because at last it appears that within the near future we will have truly international symbols that show at a glance what logic operations are performed without the need for supporting text.

The book, which is in three parts, takes the reader gently, and in a logical manner, from definitions and composition of the symbols, through a comprehensive description of the use of the symbols at all levels, to two short final chapters dealing with operations that fall outside the scope of the IEC standard. Finally, there are two appendices: the first, a glossary of symbols and notations; the second, a list of participating countries. There is also a useful alphabetical index.

Mr Kampel is at great pains to emphasize that the new symbols are no mere substitute for the old ones and, indeed, they are not! Professional engineers may find, in times to come, that they cannot properly carry out their work without a thorough knowledge of the new symbols. Serious amateurs who do not acquaint themselves with the new symbols may one day discover that they cannot understand the data sheets supplied with the new ICs or logic devices!

Butterworths
Borough Green
Sevenoaks
Kent TN15 6BR
Telephone: (0732) 884567

File handling on the BBC Microcomputer

by Brian J Townsend
ISBN 0 333 36808 8
Price £6.95

Although the name computer may make us think of arithmetical operations, it can, of course, do many other things as well, for instance, word processing and data handling. *File handling on the BBC Microcomputer* shows the reader the way in the world of data handling. Basically, it is a home-study course which slowly but very clearly sets out how a data base can be arranged from BBC BASIC. Since Brian Townsend assumes, correctly in most cases, we feel, that the reader does not know much about file handling <one of the most difficult parts of BASIC> he slowly acquaints the reader with the arranging of different types of data. Each chapter ends with a number of exercises that test the reader's comprehension. A BBC micro with at least a disc drive is the minimum equipment required. The book carefully progresses towards a complete data base in BASIC, with which it is possible to sort, select, and update any given record in any given file, and to print the record. Anyone who has read and understood the book should be able to arrange a versatile data base. Since all operations are in BASIC, everything is very clear. None the less, it is a pity that Mr Townsend makes no mention of the possibilities of working in machine language. However, this does not detract from this book forming a solid foundation for getting acquainted with data handling and all that goes with it. It can be warmly recommended to the serious BBC user who has a certain amount of experience with BBC BASIC.

MacMillan Publishers Limited
Houndmills
Basingstoke
Hampshire RG21 2XS
Telephone: (0256) 29242

Macmillan Electronic Projects Series: three new books

Three revised editions of familiar books in the Electronic Projects Series have kept us busy reading and constructing for a couple of months. Two of them — both by Graham Bishop: *Projects for the car and garage* and *Audio circuits and projects* — are well known to car and electronic hobbyists alike; not to mention the student of electronics. Neither, surprisingly, contains much new material, but this does not any way detract from their usefulness or the enjoyment provided by the circuits.

Cost-effective electronic construction is aimed at readers who have some experience of electronic construction and shows how to arrive at the least expensive and simplest way of designing a circuit or of solving an electronic problem.

All three books are thoroughly pratical in their approach and contain full details on the construction and testing of each circuit. As they are, moreover, realistically priced, we unhesitatingly recommend them to the serious constructor and to the student of electronics.

Projects for the car and garage

by Graham Bishop
ISBN 0 333 37220 4
Price £4.95

Audio circuits and projects

by Graham Bishop
ISBN 0 333 37221 2
Price £5.95

Cost-effective electronic construction

by John Watson
ISBN 0 333 37222 0
Price £5.95

MacMillan Education Limited
Houndmills
Basingstoke
Hampshire RG21 2XS
Telephone: (0256) 29242

The primer of high-performance in-circuit testing

Factron's 96-page book is intended as a light-hearted easy-to-read source of information, designed to introduce the reader to the world of high-performance in-circuit testing.

Beginning with the question 'What is a PCB?', the introductory chapter covers the production, assembly, and test of the various PCB technologies in use today; the problems likeliest at each stage; the types of ATE available to deal with them; and the costs of different test approaches.

The second chapter covers the basic issues of interest to all in-circuit ATE users — such as shorts-scanning, guarding, fixturing, backdriving, 3-, 4- and 6-wire Kelvin measurements, quadrature testing, broadsiding, timing and formatting. It provides a checklist of in-circuit tester features under the headings of Timing and pattern generation, Test driver support, Debugging capability, and Fault isolation facilities.

The chapter on In-Circuit Economics is aimed at the test manager who requires knowledge of how to analyse ATE cost/performance or produce a simple cost justification for a proposed ATE purchase. Yield economics (defined as "more bang per buck") is the objective, and achieving it is a matter of creating a well-controlled process.

The glossary explains the key in-circuit terms from Accuracy to Yield, cutting through much of the technical jargon generated by ATE. It also spells out the meaning of the many acronyms, from ATE to VLSI, used in the industry.

The book is available from the

Marketing Communications Department
Factron-Schlumberger
Ferndown Industrial Estate
Wimborne
Dorset BH21 7PP
Telephone: (0202) 893535

New catalogues

The new Cricklewood Electronics catalogue offers a great variety of electronic components for over-the-counter, mail order, or phone-in orders. The customer is promised super service, competitive prices, and speedy delivery. Get your copy now from

Cricklewood Electronics Limited
40 Cricklewood Broadway
London NW2 3ET
Telephone: (01) 450 0995
(01) 452 0161

Kit News offers technical tips, modifications, ideas, and product news from

Cambridge Kits
45 Old School Lane
Milton, Cambridge
Telephone: (0223) 860150

Electrovalue's handy-sized, 48-page catalogue is crammed full of components, tools, accessories, cases, and instruments for the electronics constructor.

Electrovalue Limited
28 St Judes Road
Englefield Green
Egham
Surrey TW20 0HB
Telephone: (0784) 33603
or
680 Burnage Lane
Manchester M19 1NA
Telephone: (061) 432 4945

The *Anglia Components Catalogue* for 1985 is nicely presented in some 130 pages, covering a host of electronic components, electro-mechanical devices, hardware, tools, test equipment, and technical information. It contains a detailed index and is available from

Anglia Components
Burdett Road
Wisbech
Cambs PE13 2PS
Telephone: (0945) 63281

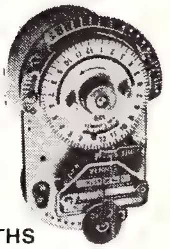
£1 BAKERS DOZEN PARCELS

(all £1 each 13 for £12)

All parcels are brand new components price £1 per parcel — if you order 12 then pick another free

BD115 — 1 Wall mounting thermostat with thermometer
BD116 — 3 pairs small and 2 pairs medium insulated croc clips
BD117 — 4 pairs large croc clips (car battery type)
BD118 — 1 Teak look 5" extension speaker cabinet with back
BD119 — 2 fibreglass fire fronts log effect & coal effect
BD120 — 2 component boards with 2 amp 400v bridge rectifier and 15 other recs
BD121 — 4 push push switches for table lambs etc
BD122 — 10 mtrs twin flex, screened and outer pvc covered
BD123 — 100 staples for thin flex white plastic and hardened nail
BD124 — 25 clear plastic lenses 1¾" diameter
BD125 — 4 items: rev per hour mains motor, counter, coin switch and srbp panel
BD126 — 4 pilot bulb lamp holders bakelite batten type
BD127 — 4 pilot bulb lamp metal clip on type
BD128 — 10 very fine drills for pcbs etc.
BD129 — 4 extra thin screw drivers for instruments
BD130 — 2 centre zero panel meters 100-0-100 μA
BD131 — 1 100 μA edge wise balance meter
BD132 — 2 plastic boxes with windows, ideal interrupted beam kits
BD133 — 1 Microsonic radio case in leather zipper pouch
BD134 — 10 model aircraft motors — require no on/off switch, just spin
BD135 — 10 large and 20 small Screwit porcelain connector/insulators
BD136 — 2 car radio speakers 5" round 4 ohm made for Radiomobile
BD137 — 1 5" 4 ohm speaker and matching tweeter 5 watt
BD138 — 1 9" × 4" 8 ohm 5 watt speaker
BD139 — 4 600 ohm microphone/speaker inserts
BD140 — 1 waterproof metal cased plug and socket 3 pin
BD141 — 10 miniature slide switches 2 pole c/o
BD142 — 10 4 ba spanners 1 end open, other end closed
BD143 — 5 100k multi turn pots with knob
BD144 — 10 chassis mounting fuse holders for 5 mm fuses
BD145 — 24 reed relay kits 3v coil can be normally open or c/o
BD146 — 20 pilot bulbs 6.5v 3a Philips
BD147 — 1 Secret switch kit with data
BD148 — 1 Printed circuit kit with data and 100 circuits
BD149 — 4 socket covers (protect inquisitive little fingers) for twin 13A
BD150 — 5 socket covers (protect inquisitive little fingers) for single 13A
BD151 — 20 4 way terminal blocks 3A 250v bakelite body
BD152 — 1 Air or gas shut off valve — clockwork operated
BD153 — 1 Air or gas shut off valve — thermostat operated
BD154 — 1 12v drip proof relay — ideal for car jobs
BD155 — 3 Varicap push button tuners with knobs
BD156 — 2 pairs Ferrite cores Neosid 56 × 18 mm
BD157 — 6 2 circuit micro switches — Licon ideal for Joystick
BD158 — 5 12 way connector blocks 2A 250v
BD159 — 3 12 way connector blocks 25A 250v
BD160 — 6 pairs 3 way connectors plug in, terminal block type
BD161 — 1 13A panel socket MK ref 735 WH1
BD162 — 1 13A fused and switched spur for surface mounting or can be removed from box for flush mounting
BD163 — 3 13A sockets good British make but brown
BD164 — 2 13A switched sockets good British make but brown
BD165 — 1 13A panel switched socket on base for surface mounting
BD166 — 1 30A panel mounting toggle switch
BD167 — 1 8 pin flex terminating plug and chassis mounting socket (s.h.)
BD168 — 2 50 tag component mounting strips
BD169 — 4 Short wave air spaced trimmers 2 — 10 pf
BD170 — 2 Hivac numicator tubes neon type
BD171 — 1 Shocking coil kit with data — have fun with this
BD172 — 10 12v 6w bulbs Philips m.e.s.
BD173 — 1 6v d.c., solenoid with plunger 1" travel
BD174 — 2 end of travel c/o switches — very robust mounted on heavy metal plate 10A 250v
BD175 — 1 200 rpm motor mains operated 2 watt
BD176 — 4 heavy duty push switches — ideal for foot operation 3A 250v
BD177 — 5 Lilliput bulbs 12v
BD178 — 3 Oblong amber indicators with lilliputs 12v
BD179 — 3 Oblong amber indicators with neons 240v
BD180 — 6 round amber indicators with neons 240v
BD181 — 100 p.v.c. grommets 5/8 hole size
BD182 — 1 short wave tuning condensor 50 pf with ¼" spindle
BD183 — 1 two gang short wave tuning condenser with ¼" spindle
BD184 — 1 three gang tuning condenser each section 500 pf with trimmers and good length ¼" spindle
BD185 — 4 ferrite rod aerials 8" × 3/8" rods with long and medium wave coils
BD186 — 1 3 wafer switch: 18 pole 2 way, 12 pole 3 way, 9 pole 4 way, 6 pole 6 way, 3 pole 12 way, your choice
BD187 — 22 wafer switches 12 pole 2 way, 8 pole 3 way, 6 pole 4 way, 4 pole 6 way, 2 pole 12 way, any 2 your choice
BD188 — 1 plastic box sloping metal front, size 160 × 95 mm average depth 45 mm

VENNER TIME SWITCH



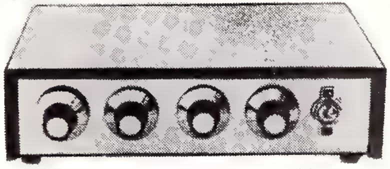
Mains operated with 20 amp switch, one on and one off per 24hrs. repeats daily automatically correcting for the lengthening or shortening day. An expensive time switch but you can have it for only **£2.95** without case, metal case — **£2.95**, adaptor kit to convert this into a normal 24hr. time switch but with the added advantage of up to 12 on/offs per 24hrs. This makes an ideal controller for the immersion heater. Price of adaptor kit is **£2.30**.

Ex-Electricity Board.
Guaranteed 12 months.

12 volt MOTOR BY SMITHS

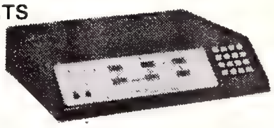
Made for use in cars, etc. these are very powerful and easily reversible Size 3½" long by 3" dia. They have a good length of ¼" spindle 1/10 hp £3.45
1/8 hp £5.75. 1/6 hp £7.50

SOUND TO LIGHT UNIT



Complete kit of parts for a three channel sound to light unit controlling over 2000 watts of lighting. Use this at home if you wish but it is plenty rugged enough for disco work The unit is housed in an attractive two tone metal case and has controls for each channel, and a master on/off. The audio input and output are by ¼" sockets and three panel mounting fuse holders provide thyristor protection. A four pin plug and socket facilitate ease of connecting lamps. Special price is **£14.95** in kit form.

PRESTEL UNITS



These are brand new and we understand tested, came with manufactuer's guarantee now void as the manufacturer no longer trade.
These originally sold for over £150. We offer then complete, except for 7 plug in i.c.s. and price is only **£14.95** (less than the value of the modem included).

YOUR TELEPHONE

Can be frustration free with the ABS one push dialling unit. You program its index with up to 220 of your important numbers.
From then on all you do is flip the index to the person you want, press the call button and the number will be dialled automatically (numbers not worth programming can be still be fast push button dialled). Should the number be engaged whether it is in your index or not it will be memorised and at a touch of the button you can try again.
Another big feature — the built in speaker and microphone allow you to have your hands free for other jobs whilst awaiting your call. The ABS unit is B.T. approved and simply plugs into a B.T. socket and a mains point. We have 50 only of these, so send or phone your order TO-DAY the price **£57.50** but you will save this in a few weeks even if you value your time at only 10p a minute

CORDLESS TELEPHONES

"IT'S FOR YOU-OU" even if you are in the bath, its an infinite extension any room and even in the garden - have one on approval or come and try one here. BT approved **£120** not yet approved **£69**. plus £2 post.

SOCKETS PLUGS ETC for BT phones

Master socket (has surge arrestor — ringing condenser etc) and takes B.T plug	**£3.95**
Extension socket	**£2.95**
Dual adaptors (2 from one socket)	**£3.95**
Cord terminating with B.T. plug 3 metres	**£2.95**
Kit for converting old entry to new B.T. master socket and one extension complete with 4 core cable, cable clips and extension socket	**£11.50**

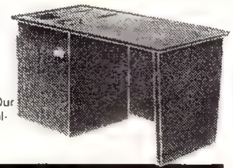
25A ELECTRICAL PROGRAMMER

Learn in your sleep. Have radio playing and kettle boiling a you wake — switch on lights to ward off intruders have a warm house to come home to. You can do all these and more. By a famous maker with 25 amp on/off switch. Independent 60 minute memory jogger.
A beautiful at **£2.50**

THE AMSTRAD STEREO TUNER

This ready assembled unit is the ideal tuner for a music centre or an amplifier, it can also be quickly made into a personal stereo radio easy to carry about and which will give you superb reception.
Other uses are a "get you to sleep radio", you could even take it with you to use in the lounge when the rest of the family want to view programmes in which you are not interested. You can listen to some music instead.
Some of the features are: long wave band 115 — 170KHz, medium wave band 525 — 1650KHz, FM band 87 — 108MHz, mono, stereo & AFC switchable, fully assembled and fully aligned. Full wiring up data showing you how to connect to amplifier or headphones and details of suitable FM aerial (note ferrite rod aerial is included for medium and long wave bands). All made up on very compact board. Offered at a fraction of its cost **only £4.95**

COMPUTER DESKS



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Computer desks size approx 4' × 2' × 2'6" high formica covered, cost over £100 each. Our price only **£9.50** — you must collect — hundreds supplied to schools

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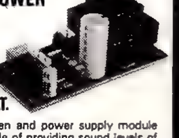

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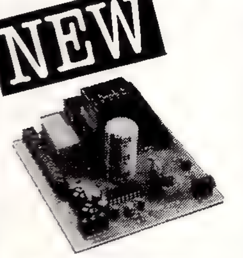

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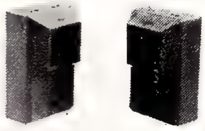

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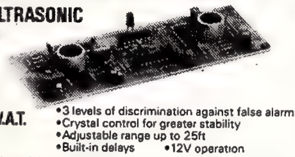

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- Built-in delays
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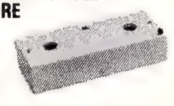

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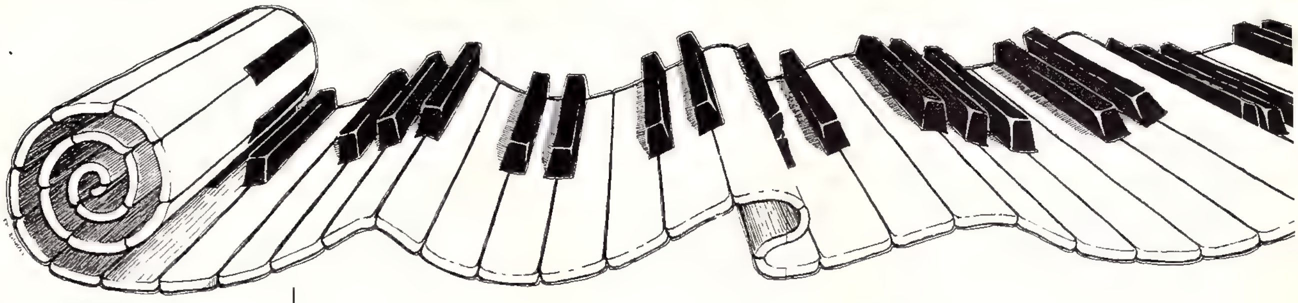
sound rotator



by T S Norris &
M M Bhalsod

Audio signals produced by electrophonic instruments, such as electric pianos, organs, and synthesizers, often sound rather artificial and thin, lacking the natural colour of acoustic instruments. Early in electronic organ development, it was realized that a mechanically rotating speaker system (sometimes known as a Lesley speaker system) partially overcame this limitation by providing phase shifts that produce interference, both constructive and destructive, at a number of frequencies in the audio spectrum, which gives vitality and interest to the resulting sound.

When two speakers rotate around one another, there exist constantly varying time delays — and therefore phase shifts — in the paths the sound takes to travel from the loudspeakers to the listener. A similar effect can be produced electronically by the use of a delay line with varying time delay.

A charge-coupled device consists of an array of MOS capacitors that are coupled, so that charges can be moved through the semiconductor substrate in a controlled manner. Although essentially an analogue shift register for use in signal processing, the CCD can perform a wide variety of electronic functions.

The schematic diagram of the sound rotating circuit, which uses a CCD (charge-coupled device) delay line IC, is shown in Fig. 1. The input signal passes along one route to the mixing amplifiers, and along another to the delay line circuit. Filters are required before and after the delay line, because a difference frequency, $f_d = f_s - f_i$, is produced in the delay sampling process, where f_s is the delay line clocking frequency; f_i is any input frequency; and f_d is the difference frequency. Delayed signals u_{del} and $\overline{u_{del}}$ are then mixed with the original input signal to produce output signals $u_{o(R)}$ and $u_{o(L)}$.

A high-frequency oscillator provides a clocking signal, u_{clk}, to pass charge packets along the delay line. The clocking signal is frequency-modulated by signal u_m that is provided by a low-frequency sweep oscillator.

Circuit description

The circuit diagram of the sound rotator is shown in Fig. 2: IC_1 is the sweep oscillator; IC_2 and FF_1 form the clocking oscillator; IC_4 is the delay line; A_1 (IC_5) is the first, and A_2 is the second, low-pass filter; A_3 and A_5 are the mixers; and A_4 is the phase inverter.

The frequency determining components for IC_1 and IC_2 are R_1-C_2 and R_7-C_5 respectively, but the voltage at their pin 5 also influences the output frequency. The frequency of IC_1 can be set between 0.2 and 6 Hz with P_1. The shape of the output at pin 4 is triangular, but this is transformed to near sinusoidal by low-pass network R_3-C_3. The voltage across C_3 is used to frequency-modulate clocking oscillator IC_2.

The output of IC_2 is a rectangular voltage (at pin 3) at a frequency of about 120 kHz. D-type bistable FF_1 halves the frequency and shapes the signal to a square wave (duty factor = 1:1).

Delay line IC_4 is fed with both the Q and the $\overline{Q}$ output of FF_1; these signals are, of course, in antiphase.

Opamp A_1 (IC_5) is a low-pass filter that reduces aliasing caused by the input signal being sampled at the 60 kHz clocking frequency. The filter has a cut-off frequency of about 15 kHz with a 12 dB roll-off.

The filtered signal is applied to the input (pin 5) of the delay line via C_9. The input pin is also provided with bias voltage preset by P_2. The output of the delay line is fed to the second low-pass filter, A_2, via SET BALANCE preset P_3 and C_{14}.

Low-pass filter A_2 prevents high-frequency clocking signals from reaching the mixer amplifiers; its characteristics are similar to those of filter A_1.

The original input signal is applied in equal proportions to the non-inverting inputs of mixers A_3 and A_5. The level of the delayed signal fed to A_3 via R_{22}, and to

A_5 via R_{25} and phase inverter A_4, is adjusted by SET DELAY SIGNAL LEVEL control P_4.

Construction and testing

The TDA1022 delay line should be treated with care, because it is a MOS IC that has no special protection against static electricity.

When the construction of the circuit has been completed, a 9...15 V supply should be connected and the operating current measured: this should be around 25 mA. Note that once the preset controls have been set at a certain supply voltage, they may have to be reset if the level of the supply voltage is changed.

Check with an oscilloscope that the signal at pin 3 of IC_2 is about 120 kHz. If the measured frequency is very different from this value, change R_7 by trial and error: a smaller value for this component causes a higher frequency, and vice versa. At the same time, check that there is slight frequency modulation on this signal.

Check with an anologue voltmeter — set to the 10 V AC range — connected between pin 4 of IC_1 and earth, that IC_1 oscillates. Also, check with P_1 that the output frequency is adjustable.

Next, inspect the signal at the wiper of P_3; bias control P_2 should be adjusted to give a voltage of 5...6 V at this point. The signal here should show some high-frequency clocking residue.

Then, adjust P_3 to minimize the clocking residue on the signal at the output of A_2.

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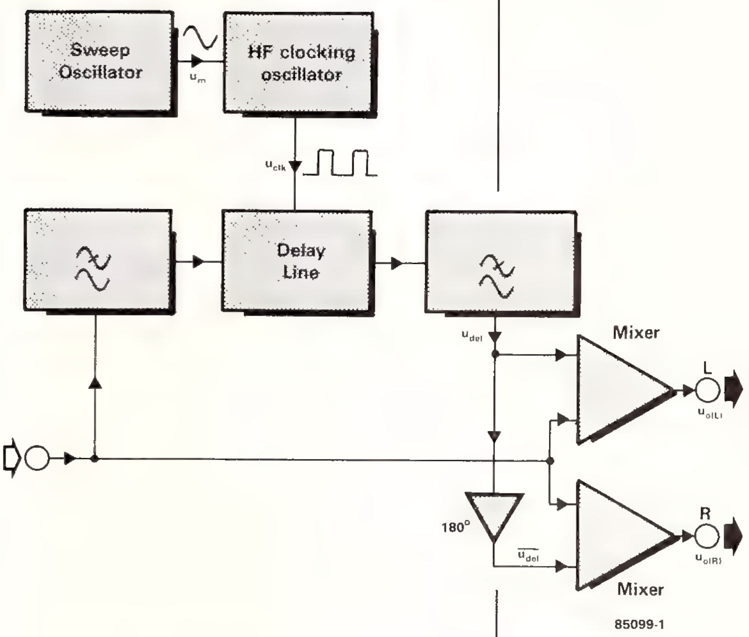

Figure 1. Schematic representation of the principle of operation of an electronic "Lesley system".

Figure 2. The circuit of the sound rotator is based on a charge-coupled device <CCD> Type TDA1022.

Finally, apply a suitable signal (from a signal generator, organ, or synthesizer) to the input terminals, and adjust P_4 and P_5 to give the desired "sound rotation" effect to the signal at the output terminals.

Finally

The sound rotator is suitable for signal levels up to about 1 V r.m.s. and is intended to be installed prior to a power

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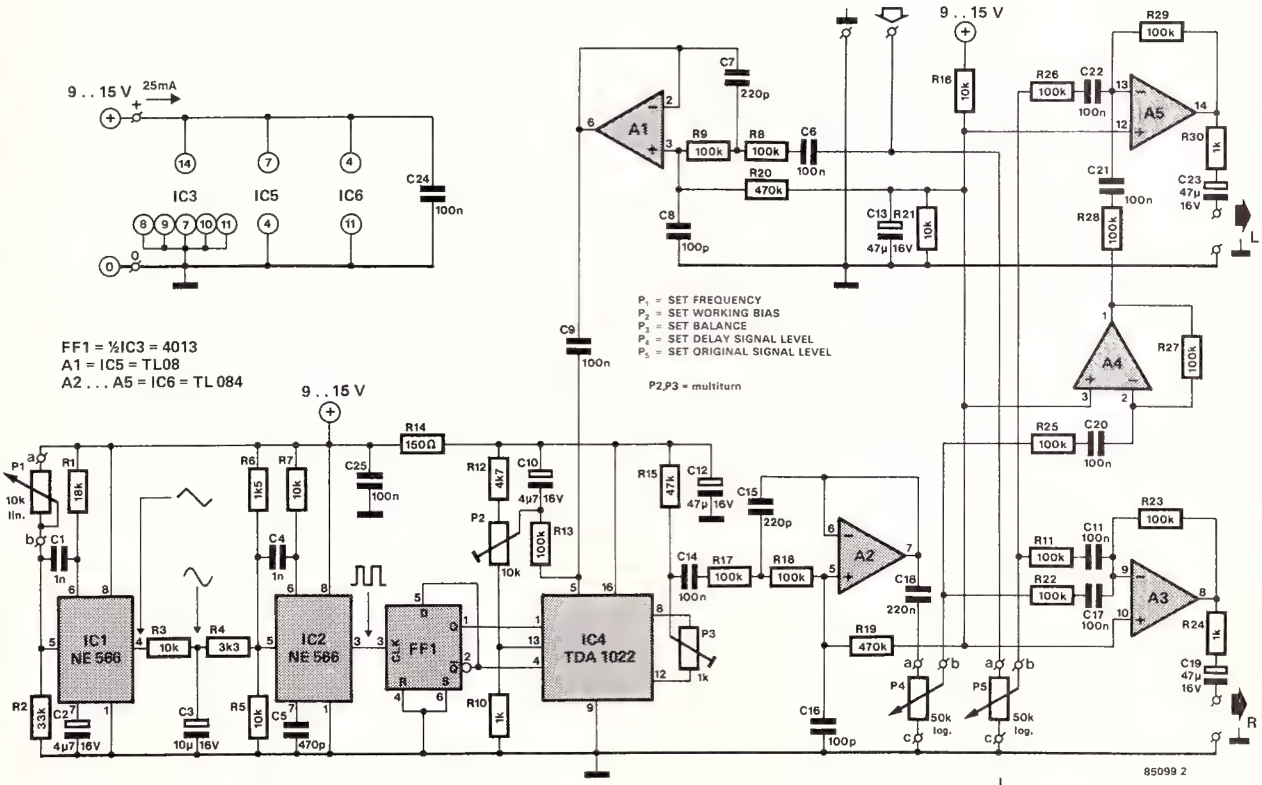

Figure 3. The printed-circuit board for the sound rotator.

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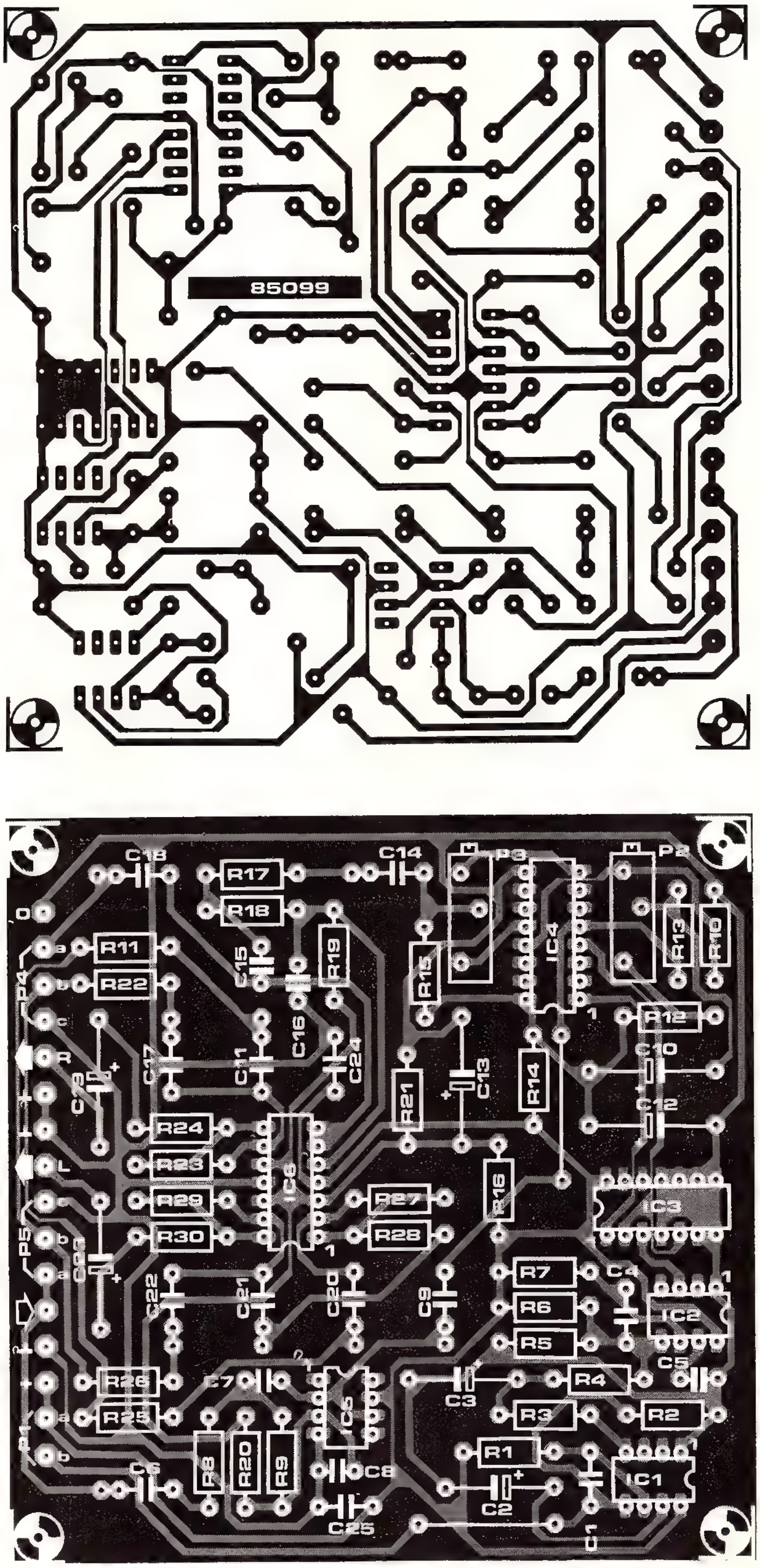


Parts list

Resistors:

R_1 = 18 k
R_2 = 33 k
R_3;R_5;R_7;R_{16};R_{21} = 10 k
R_4 = 3k3
R_6 = 1k5
R_8;R_9;R_{11};R_{13};R_{17};R_{18};R_{22};
R_{23};R_{25}. . . R_{29} = 100 k
R_{10};R_{24};R_{30} = 1k
R_{12} = 4k7
R_{14} = 150 Ω
R_{15} = 47 k
R_{19};R_{20} = 470 Ω
P_1 = 10 k linear potentiometer
P_2 = 10 k multiturn preset potentiometer
P_3 = 1 k multiturn preset potentiometer
P_4;P_5 = 50 k logarithmic potentiometer

Capacitors:

C_1;C_4 = 1 n
C_2;C_{10} = 4µ7; 15 V
C_3 = 10 µ; 16 V
C_5 = 470 p
C_6;C_9;C_{11};C_{14};C_{17};
C_{20}. . . C_{22};C_{24};C_{25} = 100 n
C_7;C_{15} = 220 p
C_8;C_{16} = 100 p
C_{12};C_{13};C_{19};C_{23} = 47 µ; 16 V
C_{18} = 220 n

Semiconductors:

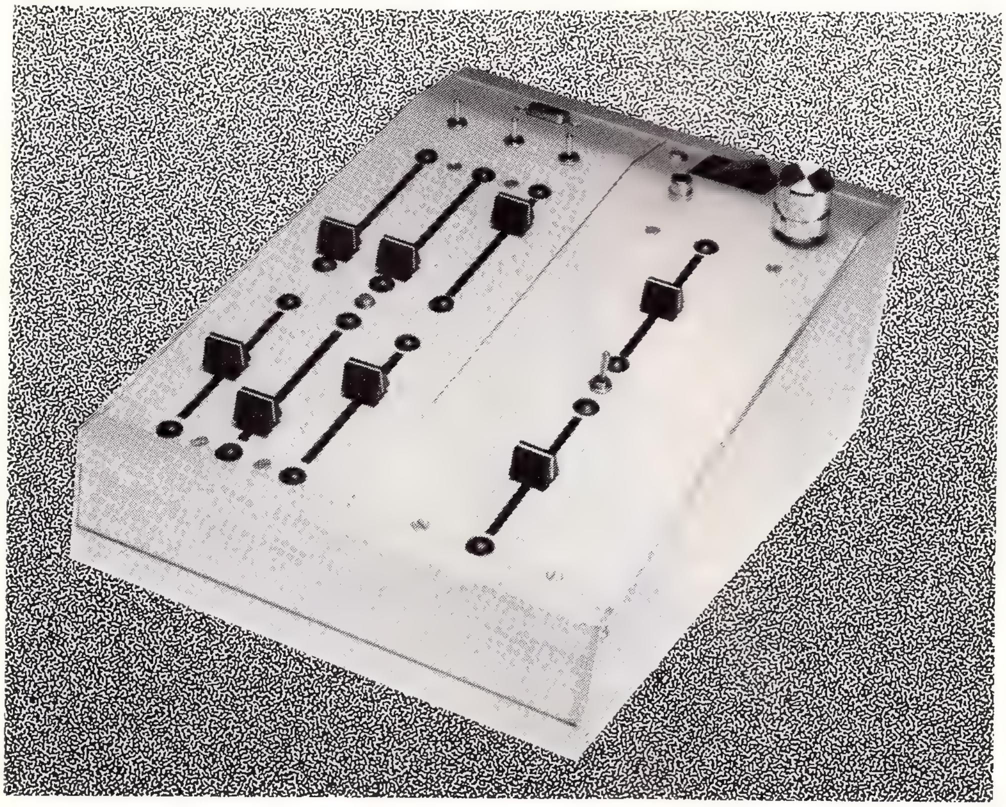
IC_1;IC_2 = NE 566
IC_3 = 4013
IC_4 = TDA 1022 (if this is difficult to obtain locally, it may be had from MB Instruments, 31 Ashvale, Cambridge, from whom other parts are also available)
IC_5 = TL 081; TL 071; LF 356
IC_6 = TL 084; TL 074

Miscellaneous;

IC sockets as required
knobs for potentiometers as required
input, output, and battery terminals
PCB 85099

amplifier. A PP3 battery can be used to operate the unit if it is, for instance, to be used in a foot-pedal or similar portable enclosure.

Our tests show that the effect of the sound rotator is most noticeable with solo instrumental music, and least when the unit is used with popular music received from the radio. In this context, it should be noted that there is not really a "Lesley effect" with monophonic music, but rather a sort of vibrato mixed with phasing. None the less, the sound of small electronic organs, synthesizers, and electric guitars and pianos will benefit from the richness imparted by the sound rotator. ■



stage lighting — 1

by A Sevriens

At this time of the year, thousands of amateur and school dramatic and music societies and groups are preparing for the coming season. A large number of these societies often wish they had a proper stage lighting installation, which permits the smooth changing and blending of lights and colours, the setting up of complete scenes with preset light intensities, and the smooth transition of light of two or more colours from one scene to the next at a controlled rate. The control panel of this type of installation can be located at a convenient place from where the operator can view the scene. Unfortunately, professional installations of this nature cost anything from a couple of thousand pounds upwards. The installation described in this and the next issue can, however, be built for a fraction of that cost.

The control panel contains two separately preset light channels. Each lamp of the stage lighting system is controlled by two independent potentiometers, I and II in Fig. 1, which are connected into circuit by a main control switch (S_2 in Fig. 1). This enables the brightness of each lamp to be preset at two different levels, as selected by the two main potentiometers. In practice, this makes it possible for a scene to be enacted, while the light levels for the next scene are being set up.

These functions are shown schematically in Figure 1. The upper group in this diagram contains the two main controls, I and II, an audio input with associated electronic circuitry, and a change-over switch S_2, which permits the desired blend to be selected. In position I, the two channels are preset independently and then mixed. In position I+II, fading of both channels is effected by preset I only. At one end of the travel of this control, channel I is operational, while at the other end, channel II is; at intermediate positions, both channels are operational to a degree which is proportional to the setting. This position of S_2, therefore, allows smooth transition from one to the other channel.

The centre group of functional blocks in Fig. 1 represents the individual channels for each lamp. The lamps are connected in groups of three. Each lamp channel is provided with two slide potentiometers, which are fed from main controls I and II. The slide potentiometers enable the brightness of each lamp to be preset at two different levels. Each group of three lamp channels is accommodated on one

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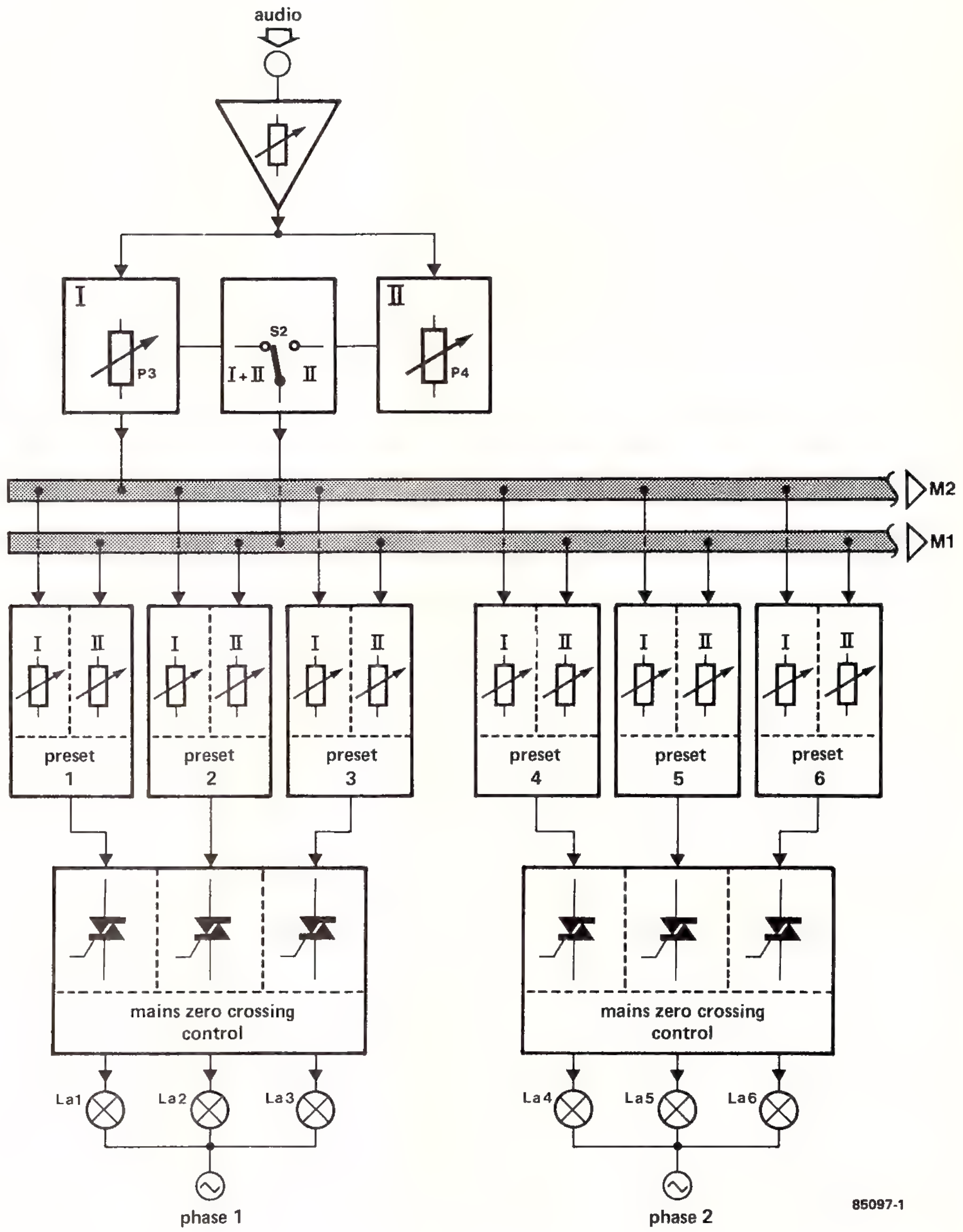

Figure 1. Block schematic diagram of a six-channel stage lighting installation. More channels may be added as shown.

printed-circuit board (PCB). Even in its smallest set up, the stage lighting control can, therefore, accommodate three spotlights.

The bottom group comprises the power stages with triac control. These stages and the wiring of the system will be discussed in Part 2 in our November issue. Suffice it to say at this stage that each group of three triacs and the zero crossing control is accommodated on two PCBs. Zero crossing control ensures minimal noise and interference being fed back to the mains, while the three triacs permit each of the three lamps to be connected to one phase of the mains. This in turn means that lamps of up to 5 kW power rating can be used. This is sufficient even for the Royal Opera House, Covent Garden! The power stages are, of course, controlled via opto-isolators, ensuring complete isolation from the mains.

Main control

The circuit diagram of the main controls and the required power supply is shown in Figure 2. This circuit, with the exception of the mains transformer, is built on one printed-circuit board.

The power supply provides a symmetrical 15 V supply as well as a 10 V reference voltage (via IC_5). Great care has been taken in the design to prevent noise and other interference being fed back to the mains supply or into the control circuit, so that spurious operation of lamps is effectively obviated.

The system can be audio controlled as

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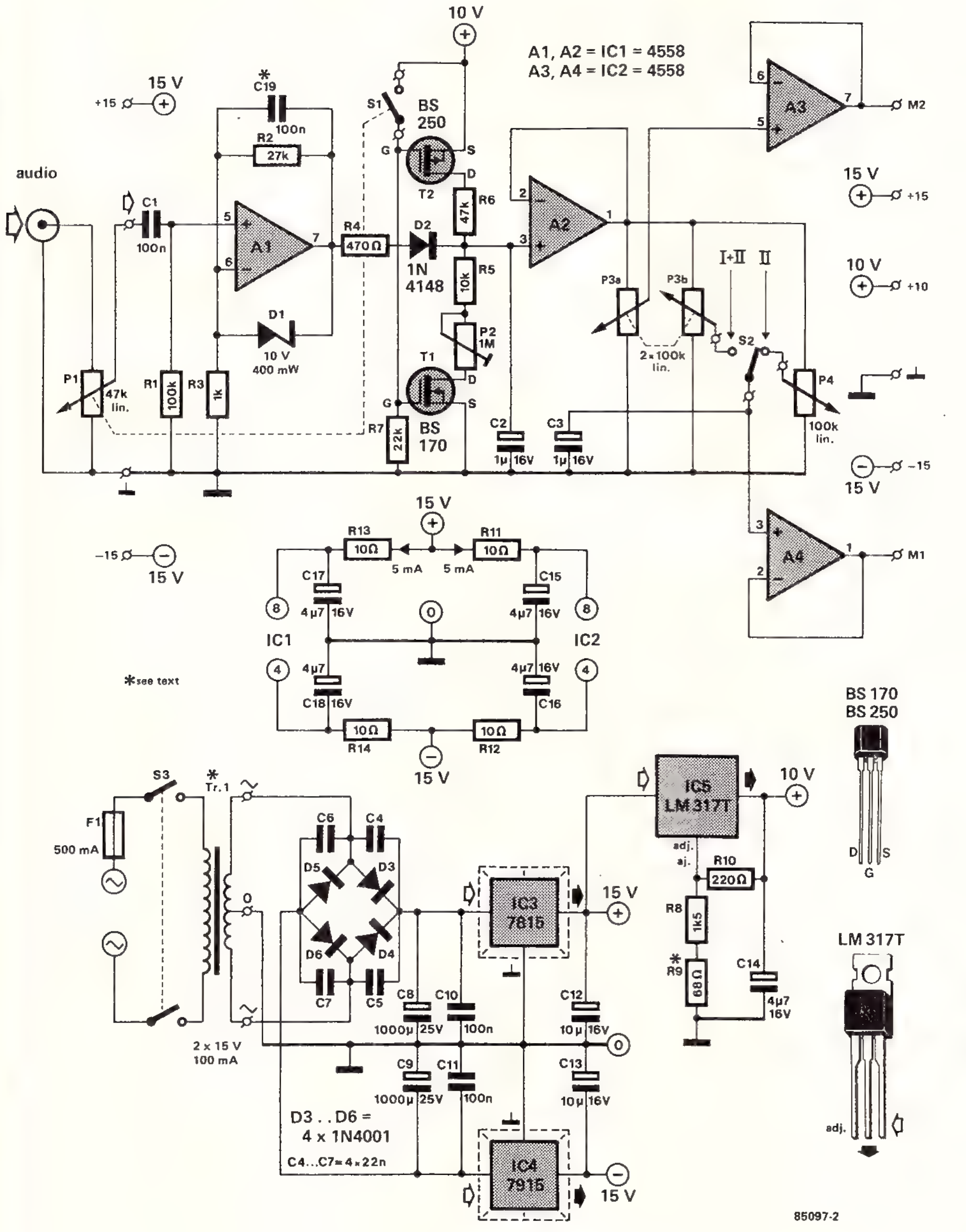


Figure 2. Circuit diagram of the main control board.

well as operated normally. The audio input is amplified and processed in opamp A_1. Potentiometer P_1, which has an internal switch, S_1, can set the input sensitivity to about 100 mV. When P_1 is turned fully anticlockwise, the audio input is short-circuited and S_1 closes. This results in T_1 switching off and T_2 conducting. The inverting input of buffer amplifier A_2 is then no longer fed with the rectified audio signal; instead, the 10 V reference voltage is applied to it, which enables normal (manual) operation.

Capacitor C_{19} limits the base response of the audio circuit; if this limitation is not required, the capacitor may have a lower value or be omitted altogether.

Preset P_2 enables setting of the drop-out time.

The 10 V reference voltage is provided by IC_5, which has a good temperature stability. The exact value of the reference voltage is determined by R_9. Should the reference voltage not be exactly 10 V, the value of R_9 should be altered by trial and error until a value of 10 V is obtained. A higher value of R_9 causes a higher value of the reference voltage.

Opamp A_2 buffers the reference voltage, which is applied to its inverting input via T_2 and R_6. Its output is applied to the two main controls, P_3 and P_4, which serve channels I and II respectively. The controls are buffered by A_3 and A_4 respectively. Note that P_3 must be a stereo potentiometer, because in the circuit as drawn with S_s set for normal operation, the buffers are fed separately by P_3 and P_4. Channels I and II can, therefore, be mixed or set independent of one another. With

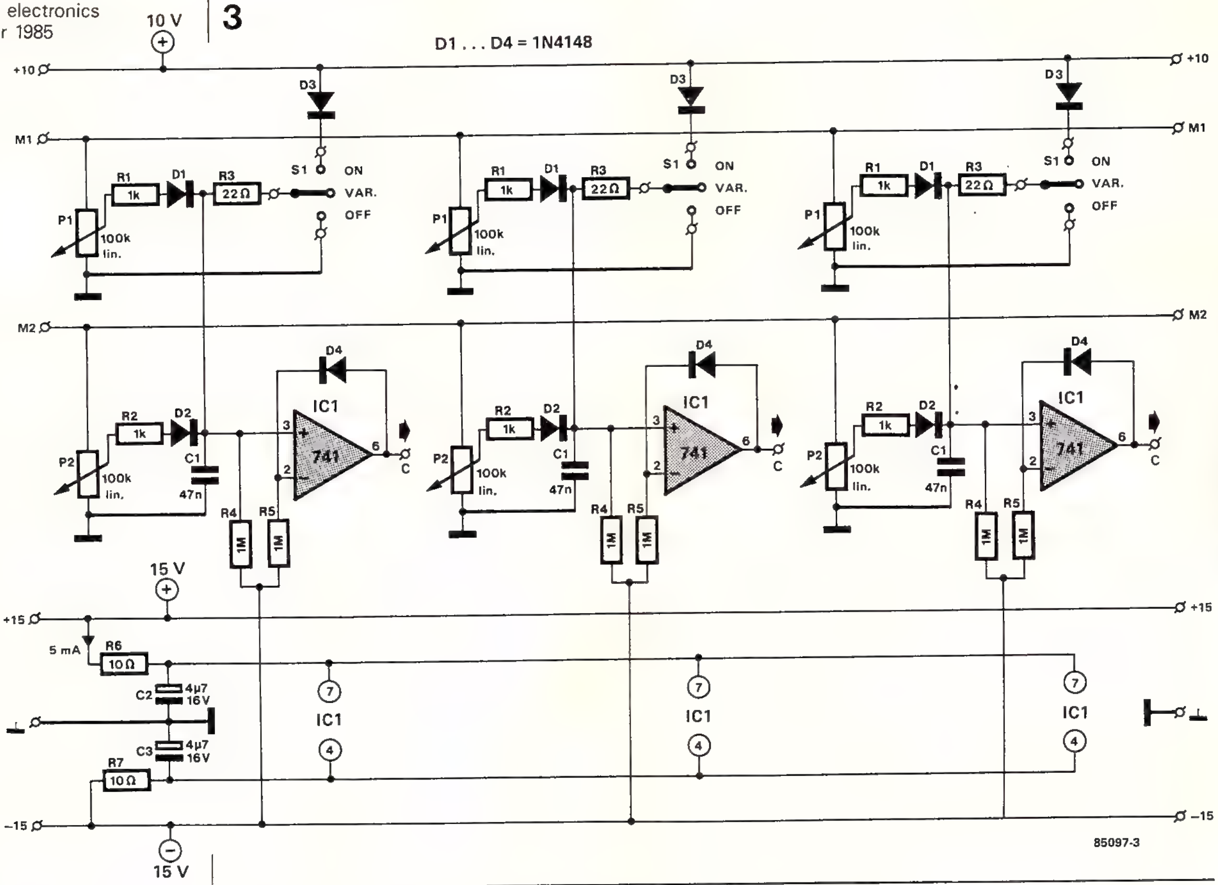


Figure 3. Circuit diagram of a lamp channel.

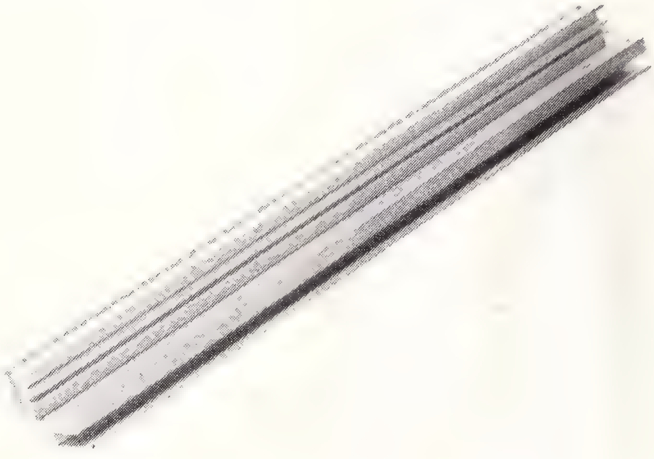
S_2 in the other position, the control voltages for Channel I (A_3) and Channel II (A_4) are both provided by P_3. The two halves of this potentiometer are in "opposition", i.e., in one of the extreme positions, Channel I is operational, and in the other, Channel II. The output voltages from A_3 and A_4 are fed to the presets on the lamp channel board(s).

Lamp channels

The circuit in Figure 3 shows that only one opamp is used for the entire lamp channel. The input voltages at M_1 and M_2 are supplied direct to presets P_1 and P_2 respectively. The voltages at the wipers of these presets are combined and applied to the inverting input of IC_1 via diodes D_1 and D_2. The diodes prevent interaction between the two presets and ensure that the higher of the two voltages determines the operation of IC_1. The 0.6 V drop across the diodes is countered by that across D_4 in the feedback loop. With full drive, the output of IC_1 is 10 V. The resulting voltage at terminal C is a measure of the brightness of the lamp connected to this channel.
An additional facility is provided by S_1, a change-over switch with open centre position. As drawn, the voltages from the presets determine the operation. When S_1 is switched to earth, the lamp goes out, since the voltages from the presets are then virtually shortcircuited by R_3. With S_1 connected to the cathode of D_3, the voltage at terminal C remains at 10 V so that the relevant lamp is held at full brightness.

Finally

Some thought should be given at this stage to the front panels. Figures 4 and 5 illustrate one possibility for the main and lamp control unit(s) respectively. Note that the position of the switches and potentiometers is determined by the printed-circuit boards. The sandwich construction results in a compact unit as shown in Figure 6.



Section of aluminium moulding which facilitates the construction of the housing.

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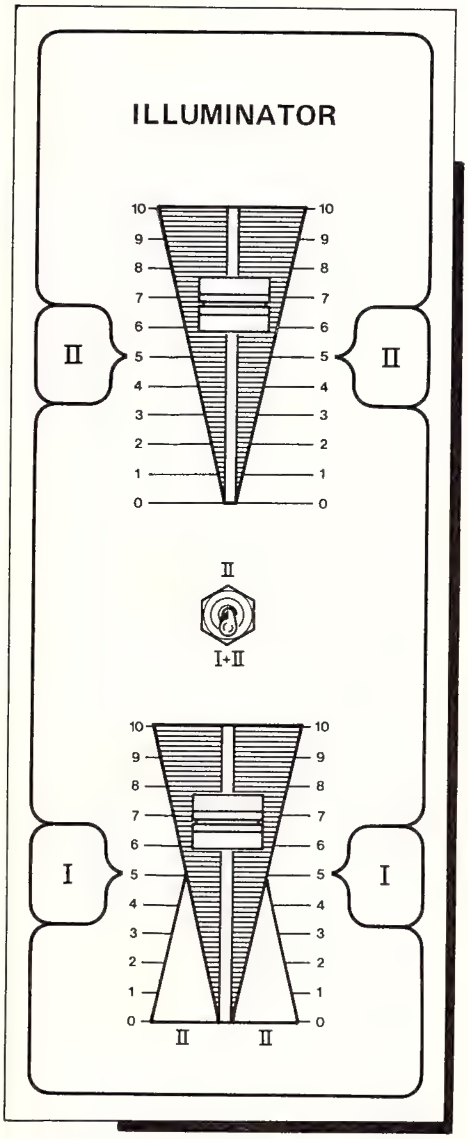

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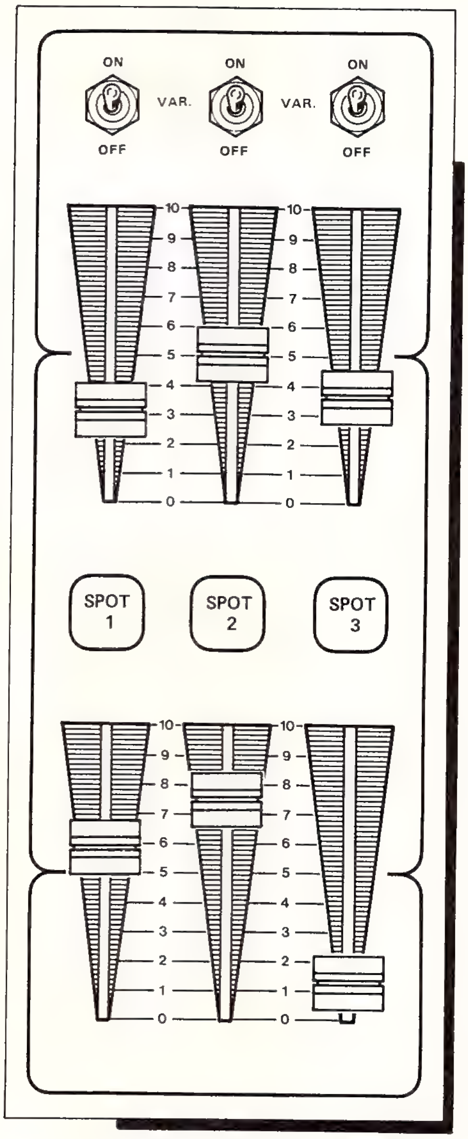

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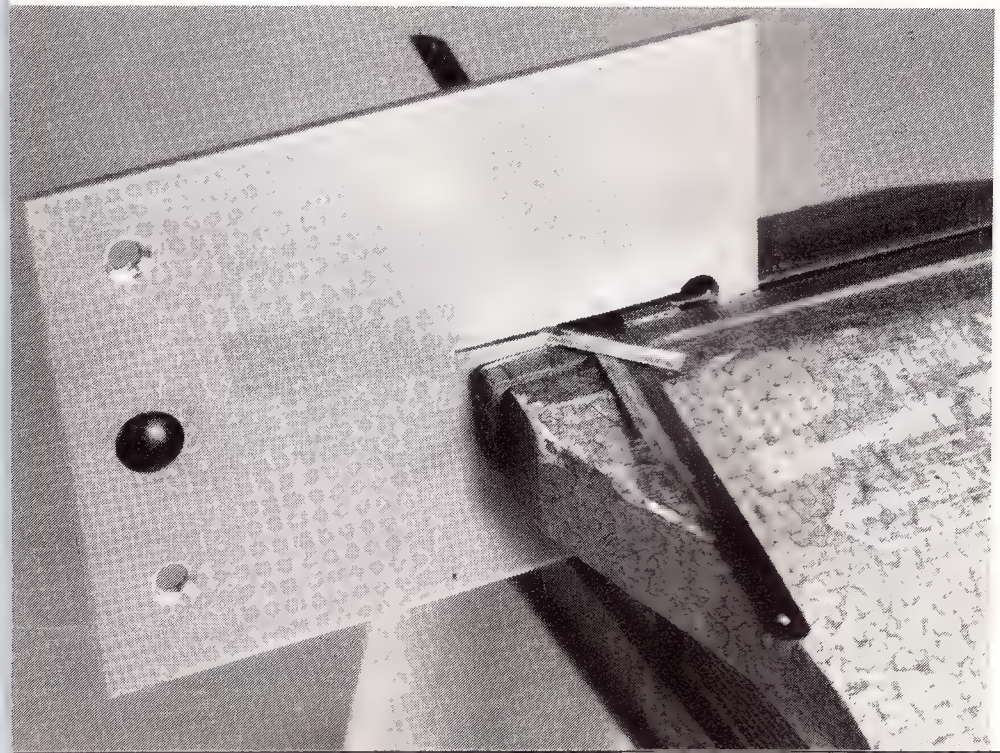
Figure 4. One possible layout of the front panel for the main control unit.

Figure 5. One possible layout of the front panel for the lamp channel unit.



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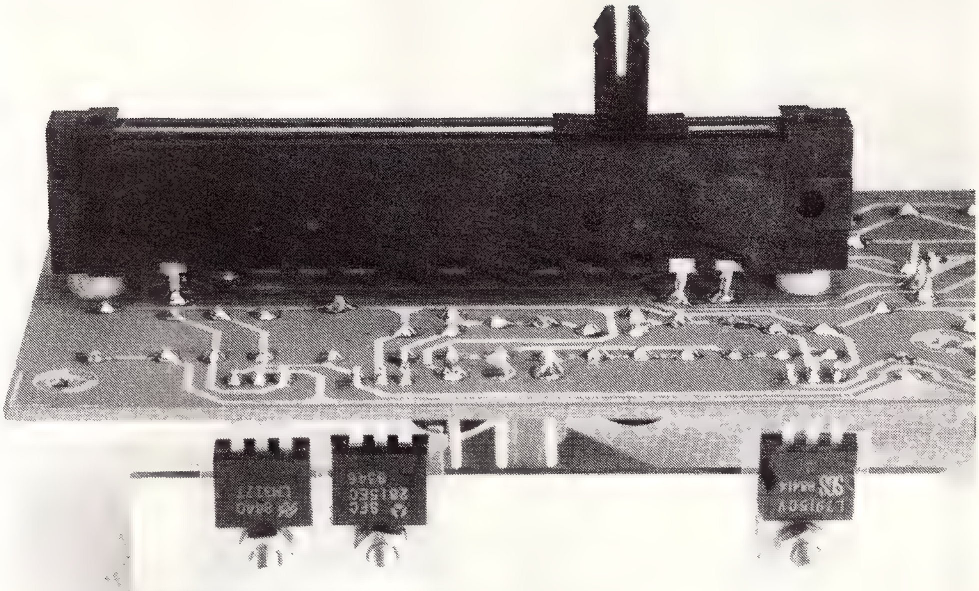

Figure 6. The slide potentiometers are soldered to the track side of the PCB, which makes it necessary for their terminals to be bent as shown by the arrow.

Before the construction is started, it is necessary to be quite clear on the size of the required unit. As stated, in its smallest form, the installation offers three lamp channels, for which one main control and one lamp channel PCB are required. Where nine lamp channels are needed, two more relevant PCBs are required. The power supply shown in Figure 2 can cope easily with this number of boards.

The housing of the control panel can be kept fairly flat and light as shown in Figure 7. The power stages, which will be discussed in detail next month, are housed in a separate enclosure and connected to the control panel by a simple control cable. The wiring in the control panel is not critical, since the boards are interconnected by simple jumpers.

It is essential that the potentiometers are of good quality, because "scratchy" ones may result in flickering lamps.

Part 2 will appear in our November 1985 issue.

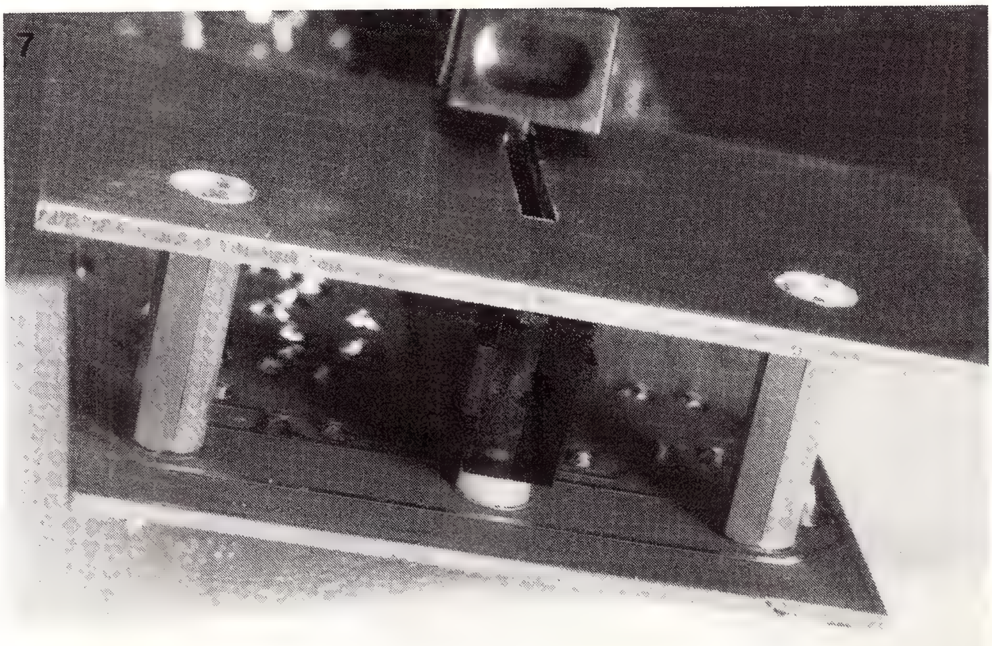

Figure 7. Illustrating how the PCBs are fitted to the front panel.

Parts list (Fig. 8)

Resistors:

R_1 = 100 k
R_2 = 27 k
R_3 = 1 k
R_4 = 470 Ω
R_5 = 10 k
R_6 = 47 k
R_7 = 22 k
R_8 = 1k5
R_9 = 68 Ω*
R_{10} = 220
R_{11} . . . R_{14} = 10 Ω
P_1 = 47 k linear potentiometer with switch
P_2 = 1 M preset potentiometer
P_3 = 100 k stereo slide potentiometer, linear, for PCB fitting
P_4 = 100 k mono slide potentiometer, linear, for PCB fitting

Capacitors:

C_1;C_{10};C_{11};C_{19}* = 100 n
C_2;C_3 = 1 μ; 16 V
C_4 . . . C_7 = 22 n
C_8;C_9 = 1000 μ; 25 V
C_{12};C_{13} = 10 μ; 16 V
C_{14} . . . C_{18} = 4μ7; 16 V

Semiconductors:

D_1 = zener diode, 10 V, 400 mW
D_2 = 1N4148
D_3 . . . D_6 = 1N4001
T_1 = BS 170
T_2 = BS 250
IC_1;IC_2 = 4558; 1458; TL 082
IC_3 = 7815
IC_4 = 7915
IC_5 = LM317T

Miscellaneous:

S_2 = single pole change-over switch
S_3 = double pole mains switch
F_1 = fuse, 500 mA, delayed action
fuse holder for F_1; single hole mounting
mains chassis socket
heat sinks for IC_3 and IC_4
mains transformer;; secondary 2 × 15 V; 2.5 VA or 4.5 VA
knobs for slide potentiometers
PCB 85097-1

*see text

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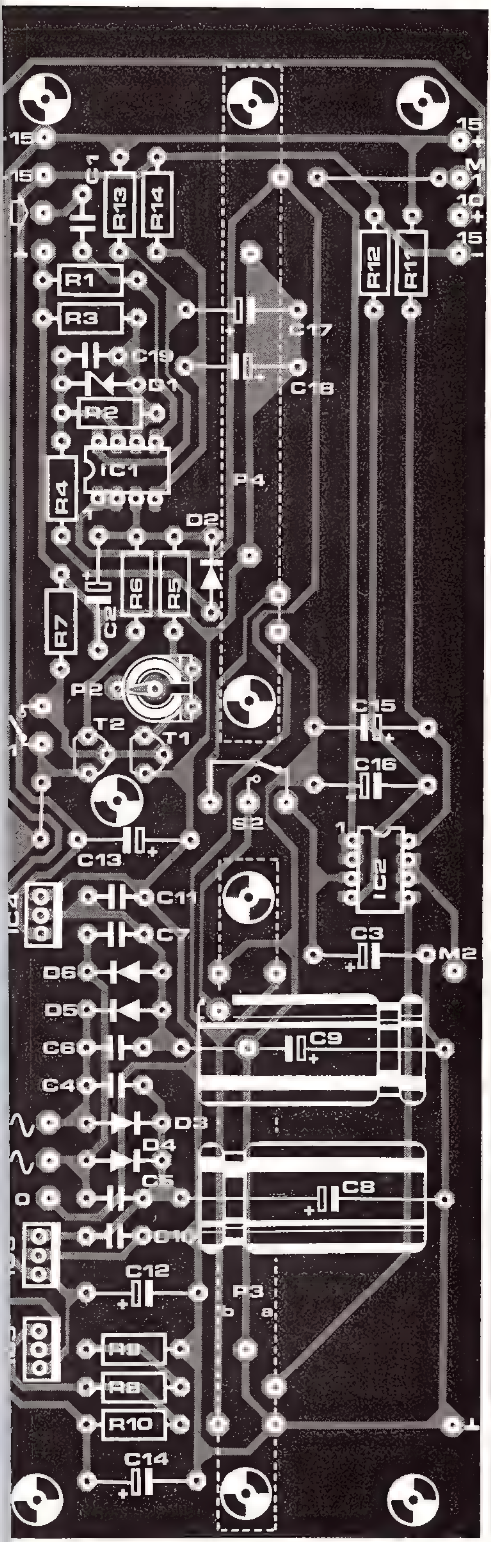

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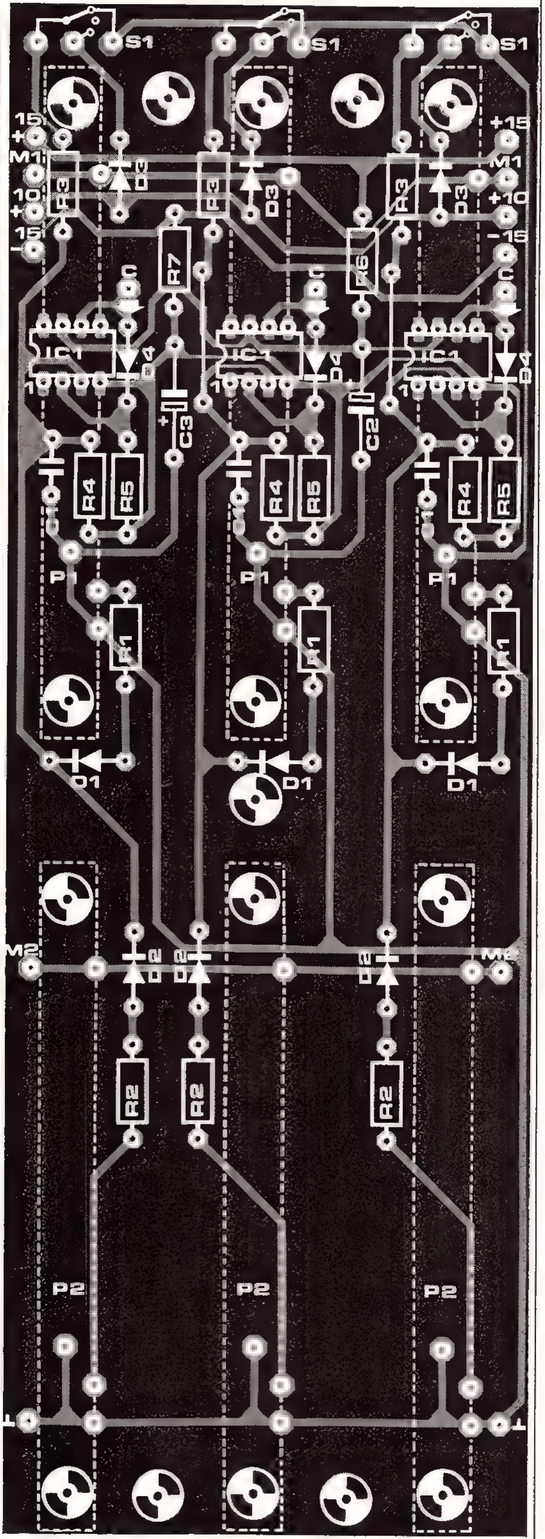


Figure 8. Main control printed-circuit board.

Figure 9. Lamp channel printed-circuit board.

Parts list (Fig. 9)

Resistors:

R_1;R_2 = 1 k
R_3 = 22 Ω
R_4;R_5 = 1 M
R_6;R_7 = 10 Ω
P_1;P_2 = 100 k mono slide potentiometer, linear, for PCB mounting

Capacitors:

C_1 = 47 n
C_2;C_3 = 4μ7; 16 V

Semiconductors:

D_1...D_4 = 1N4148
IC_1 = 741; LF 356

Miscellaneous:

S_1 = single pole change-over switch with open centre position
two knobs for slide potentiometers
PCB 85097-2

NOTE: all these parts, except the PCB itself, are required three-fold for each board.

Electronics and medicine

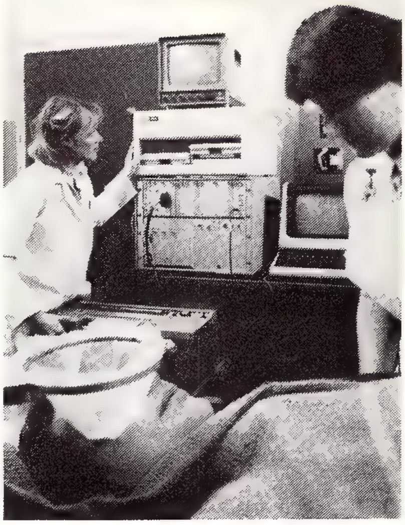
Electronic instrumentation is saving lives

The use of electronic devices and instrumentation in medical care has increased dramatically over the past 20 years and new technology is being introduced at an exciting pace. Electronic instrumentation is used to monitor the heart, brain and liver, and to measure pulse rate, blood flow, and metabolism of the human body.

It is used to determine the size, shape, and orientation of an unborn child, and to locate the presence of tumours, damaged tissue, and broken bones.

From the simple blood pressure analyser to the heart pacemaker and whole body scanner, electronic instrumentation has made possible the alleviation of suffering and the prolongation of human life to an extent that would have caused past generations to gasp in astonishment.

Among recent developments has been the pioneering of life-saving surgery by the so called *laser scalpel* developed by Barr & Stroud. This revolutionary technique was first used in the early 1980s and, in particular, in 1984 at the Oldham and District General Hospital in northwest England, by Naru Hira, senior consultant surgeon. He treated bleeding stomach ulcers and removed tumours all without open surgery and with only a local anaesthetic.



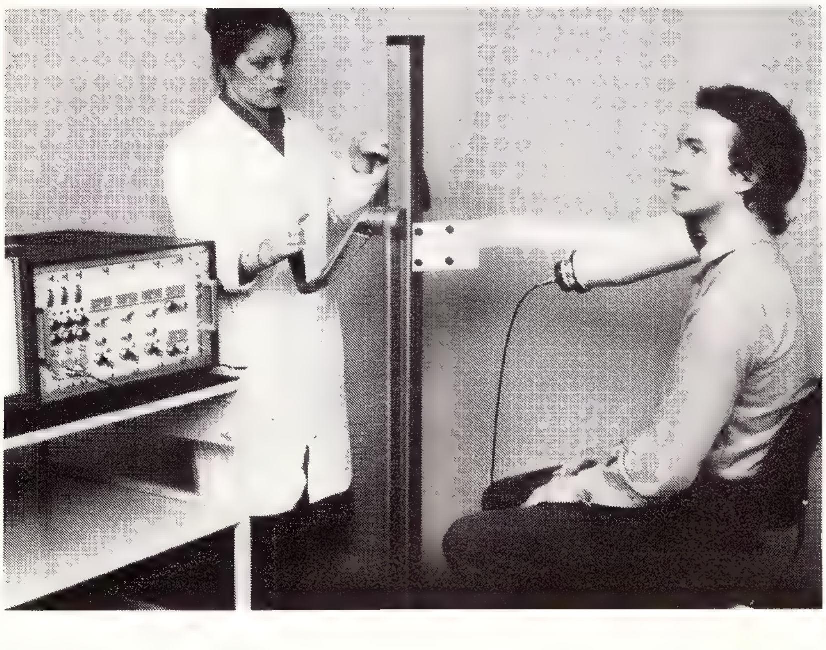
Harwell developed ultrasonic inspection system in use at Moorfields Eye Hospital, London displays ultrasonic images of the eye directly on a television screen and allows them to be recorded on a standard video recorder.

Laser Light

The Barr & Stroud technique relies upon a length of fibre optic cable being fed into the patient and carefully positioned so that its pin-head tip is aligned opposite the treatment site. The important alignment procedure is assisted by passing visible light through the cable and connecting it to a viewing device known as an endoscope.

When the cable tip is precisely positioned at the delivery site, the visible light is replaced with a short duration burst of near-infrared light derived from a powerful laser. The laser, its power supply, and all the controls are housed in a floor-standing unit that can be used anywhere in the hospital where a three phase electrical supply and mains cooling water are available. Known as Fiberlase-100, the system uses a neodymium doped yttrium aluminium garnet laser (usually described by the abbreviation Nd-YAG), which produces near-infrared light at a wavelength of 1.06 μm. At this wavelength, the laser light is able to penetrate deep into the tissue and can seal off large, bleeding vessels and destroy tumour cells. The laser power delivered to the target site is microprocessor controlled and can be delivered in pre-settable 10 W increments over the range 50 to 100 W. The laser pulse duration can be similarly pre-set over the range 0.1 to 9.9 seconds in increments of 0.1 second.

Digital displays are a very important feature of the Fibrelase-100. They can be used to indicate the energy delivered by each laser pulse, the number of pulses delivered, and the accumulated energy dose received at the target site.



This thyroid counting system from Nuclear Enterprises features a dedicated microprocessor that provides all the facilities required for operating the system.

Radioactive Tracers

An ancillary facility provided by the system is the ability to deliver carbon dioxide gas at low or high flow rates for clearing blood from the target site.

The first application of nuclear radiation in medicine took place in 1898, when Marie Curie and her husband Pierre used gamma radiation from naturally occurring radium on tumours in the human body. Since then, techniques have been developed for producing an enormous range of very useful radioactive isotopes of a type that do not exist in nature.

These so called artificial radio-isotopes are produced mainly from the neutron irradiation of non-radioactive nuclei in a nuclear reactor or, less frequenctly, from proton irradiation of such nuclei in the target chamber of a particle accelerator such as a cyclotron.

Radio-isotopes are widely used in the medical field as tracers, for example, for determining the uptake of iodine by the thyroid gland, the reaction of metabolism of the body to iron and other minerals, and the formation and utilization of fats. Tracers are also widely used to detect the presence of tumours, to measure blood volume in a limb, and to diagnose heart disease.

Picture of Heart

Many of the radio-isotopes used in Britain — and in many other parts of the world — are manufactured in two nuclear reactors and a powerful cyclotron at the Harwell Laboratory in Oxfordshire. These isotopes, in the main, are marketed by Amersham International, which has two packaging and distribution plants in Britain and exports more than 80 per cent of its products.

The Harwell laboratory has recently perfected a new production technique using its variable energy cyclotron for producing the radioactive isotope gold-195m. This new radio-isotope has a half-life of only 30.5 seconds and is used in a technique known as *single pass nuclear angiography* for investigating the dynamics of the heart.

The technique begins with the injection of a small amount of radioactive gold into the bloodstream and it quickly passes through the vessels of the heart.

A radiation detector made by Scintronix of Livingston in the Lothian Region is positioned outside the body over the heart, and is used to detect the gamma radiation emitted by the radioactive blood cells. It supplies signals to a special camera, which takes up to 60 pictures a second of the emitted radiation. The equipment uses these to build up an image of the heart for display on a conventional television monitor, and to record the data on a video recorder. The image displayed on the monitor can show the heart beating and privides information about its function and operating efficiency.

Repeated Tests

It is the short half-life of gold-195m that makes this particular isotope so valuable. Earlier techniques made use of the technetium-99m radio-isotope, but this has a half-life of six hours.

With a half-life of only 30.5 seconds the injected gold disappears from the body within a few minutes and enables the patient to be subjected to repeated tests at short intervals. The ability to do this is valuable in monitoring the performance of the heart after exercise or assessing its response to drugs or other stimuli.

The new gold radio-isotope has enabled a major advance to be made in the development of standard diagnostic tests for coronary heart disease and is being assessed at St Bartholomew's Hospital, London, and at the Western Infirmary, Glasgow.

A British company that specializes in the design, development, and manufacture of nucleonic instruments is Nuclear Enterprises of Reading. Founded in 1956, this company supplies instruments to hospitals, teaching establishments, and nuclear installations all over the world.

Ultrasonic Radiation

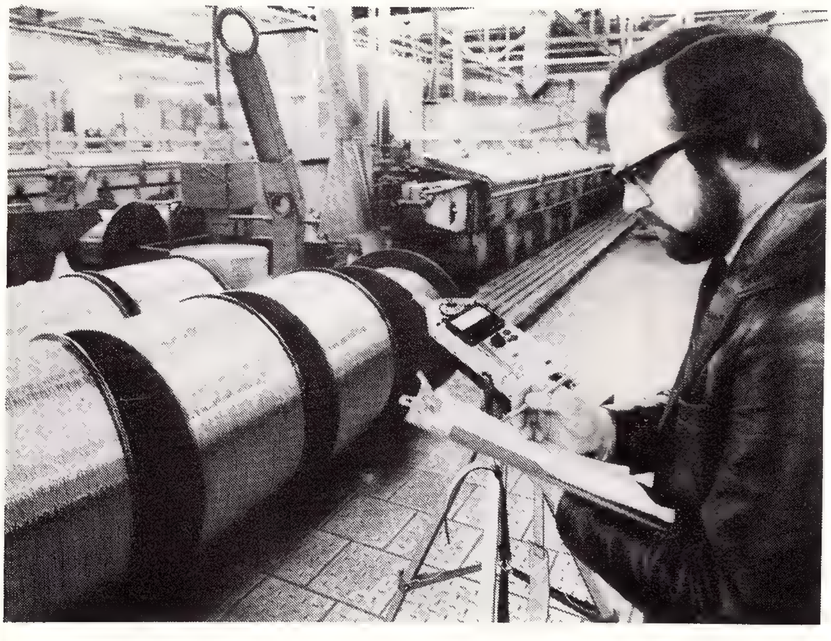
Representative of the company's nucleonic instrumentation in the medical field is its thyroid counting system. This comprises a scintillation-type radiation detector connected to a microprocessor-controlled electronics assembly. A single channel analyser is set to respond to a narrow band of gamma radiation centred on that emitted by the iodine radio-isotope contained in the patient's thyroid gland.

Signals originating in this way are fed to a ratemeter, whose output is connected to a chart recorder displaying the relationship between thyroid uptake and time.

Among many other products applicable to the medical field, Nuclear Enterprises also manufactures the Ionex dose/dose-rate meter, which allows precision routine measurements of accumulated gamma-ray dose and dose rate at therapy and patient protection levels.

Ultrasonic radiation is increasingly used in medicine because it is possible to image soft tissue structure, and it is a safer substitute for X and gamma radiation, particularly in the examination of pregnant women and of those parts of the body where there is insufficient contrast in the irradiated tissue to produce a satisfactory radiograph. A good example of the use of ultrasonics is the new data recording and imaging system developed by the Harwell laboratory for the ultrasonic eye scanner used at the Moorfields Eye Hospital, London.

The system displays ultrasonic images of the eye directly on a standard television monitor and allows them to be recorded on a video cassette recorder. The recording provides the surgeon with a permanent record of the patient's eye condition and allows images to be replayed later during diagnostic discussions.



Conducting a noise level survey in a factory.

Campaign against noise

Noise is a hazard that all too often is over-looked by workers and management who could be unaware of its harmful effects until it is too late. That is why Britain's Health and Safety Executive (HSE), the organization that checks safety at work, has launched a major campaign to redure noise levels at the place of work.

It is estimated that in the United Kingdom alone almost a million people work in noise levels high enough to create a risk to their ears. Some workers may actually suffer permanent damage. Those particularly at risk include shipbuilders, steel workers, men using pneumatic hammers, riveters and, those employed in canning factories.

A circular saw produces about 102 dB and a stockman who looks after pigs can be subjected to squeals of 108 dB. This may not sound much of a difference until it is remembered that 1 dB (decibel) is a logarithmic unit of sound intensity, so that a difference of 6 dB represents a sixfold increase in noise.

The HSE campaign hopes to increase awareness of the danger of noise and to encourage quieter machines. Noise in machinery can be dampened by enclosure — for instance, chipboard drills can be quietened by 30 dB in this way — or by special mountings that can reduce noise from vibrating machinery by 13 dB in some cases. The HSE has produced a booklet listing 100 examples of quietening tools and equipment.

Ear Protectors

Another objective is to encourage equipment manufacturers to make quieter machines. This *design against noise* campaign has received support from the Government and is gaining wider backing all the time.

The HSE is also trying to persuade

workers that when ear protectors are supplied by management they ought to be worn at all times. Noise related hearing impairment is often slow to develop, but, once it does, can be permanent.

Total or partial loss of hearing can result, or the workers may suffer from tinnitus — a constant ringing in the ears. Whatever the risk, all too often workers leave ear protectors off because they are uncomfortable.

In a more general effort to increase noise awareness, the HSE has a mobile exhibition that tours Britain, and it would welcome further legislation to control noise.

Computerized artificial hand

Doctors and biomechanical researchers are producing ingenious devices to replace defective or missing parts of the human body. Prostheses, as they are called, rarely copy the originals absolutely but, with constant advances in associated fields, such as control engineering and electronics, mechanical prostheses are getting better.

At the University of Southampton, Professor Jim Nightingale and his team have been concentrating on one part of the body where an efficient prosthesis could transform the patient's life. For the last 13 years they have been working on an artificial hand. Now, using computer technology and miniature motors, Professor Nightingale believes the team will soon have a model to go into clinical trials.

This sophisticated artificial hand, controlled by sensors and a microcomputer carried by the user, was designed at Southampton University, England.

Numerous problems face existing prosthetic hands. Many are cumbersome with a limited amount of movement. They are generally controlled by muscle stimulation in the stump and, because of poor processing of this signal, hand movements tend to be delayed and only one move can be made at a time. This is quite difficult for the patient when, for example, he wants to pick up a glass. In addition, the user has consciously to provide muscle stimulation all the time to maintain a grip.

Professor Nightingale has solved many of these problems with the help of a small personal computer that is carried by the patient. He has also designed special sensors to form part of the artificial hand and constantly feed information back to the computer.

More Sensitive Grip

This means that all the patient now has to do is to put the new hand near, say, the glass and, through the normal muscles in this arm, instruct the fingers to close. Three tiny motors in the hand control the thumb, forefinger and other fingers. They all move separately so that the hand closes on the glass with the fingers wrapped into the appropriate positions. From then on the patient can forget that he is using a prosthesis because the computer takes over. Should the glass slip, special slip sensors cause the hand pressure to be increased. The hand weighs only 450 g but can deliver a grip force of 2 kg and, with the sensors embedded in the fingers, should be almost as robust as a normal hand.

The computer that controls it is about the size of a video tape cassette but Professor Nightingale believes his team might soon be able to fit a smaller one into the hand itself. Unfortunately, the battery to power the equipment is still fairly cumbersome.

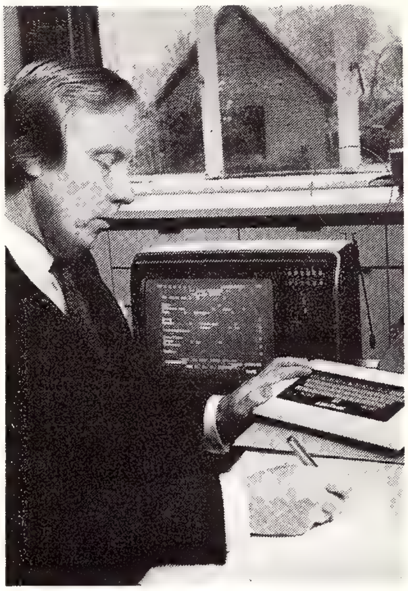
Professor Nightingale's prosthesis is still in the research stage, but the successful use of sensors and feedback with a computer that is not preprogrammed offers real hope for more natural mechanical hands.

More effective monitoring of drug safety

Britain's Committee of Safety of Medicines (CSM), which monitors the effects of drugs on patients, has initiated a trial to improve the reporting by family doctors of adverse drug reactions on patients. The pilot study will involve 300 doctors and will look at the feasibility of using microcomputers of viewdata equipment to make the reports. If the scheme is succesful, there is the likelihood that such systems will ultimately be installed in every family doctor's surgery.

The CSM normally learns about adverse drug reactions by what is known as the yellow card system. The doctor is supposed to fill in a yellow form and post it to the CSM if he has observed some side effect.

Many health workers believe this system misses too many cases. If the computerized scheme proves popular, the CSM is confident it will improve the quality and quantity of reports.



A family doctor takes part in a pilot project in Britain designed to give rapid warning of harmful side effects caused by drugs. The doctor used Prestel viewdata equipment in his surgery to feed the warning into a central data bank.

Doctors involved in the pilot study key in answers to various questions that they call up on the screen. These questions relate to specific reactions to a drug. The keyed-in information is then sent direct to the CSM by telephone link. Every family doctor has his own security code in the system and the central databanks are further protected by more complex codes so that only authorized people can gain access.

The process will speed up the assessment of a drug's safety and effectiveness. It should also permit drugs that have proved dangerous to be withdrawn immediately.

The CSM even hope to be able to tell doctors that a drug has been banned before the decision is made public through the newspapers. However, the CSM has assured doctors that the computer link will not automatically lead to more drugs than at present being taken off the market.

(LPS)

companies

Crystals from KW Communications Ltd

Following their recent appointment as sole UK distributors for an EEC crystal manufacturing company, KW Communications can now supply a wide range of crystals for communications and microprocessor applications. The crystals are available in a wide range of frequencies and holder styles, including HC6U, HC18U, HC25U, and HC33U. They comply with MIL/C/3098 for supply to NATO equipment manufacturers.

KW Communications Ltd
Vanguard Works
Jenkins Dale
Chatham, Kent ME4 5RT
Telephone: (0634) 815173

Apollo flying high

Apollo Computer Inc. recently reported net sales for the second quarter ended June 29 of \$87 548 000, nearly double those for the comparable period in 1984. Net profits for the quarter increased 43 per cent to \$7 365 000 or 21 cents per share as compared with 17 cents per share for the second quarter in 1984.

Apollo Computer Inc. manufactures dedicated, high-performance 32-bit workstations that operate in a distributed local-area network <LAN>. The company has operations in seventeen countries and has shipped nearly 12 000 workstations for use in a variety of engineering, scientific, and other technical applications.

Apollo Computer (UK) Ltd
Aegis Park
Bramley Road
Mount Farm
Milton Keynes MK1 1PT
Telephone: (0908) 366188

Midland-Ross Limited

The Electronic Connector Division of Midland-Ross Ltd — a broad-based manufacturer and marketer of electronic connectors, interconnect devices, and hardware — is to expand its Castleton, Sheffield, factory at a cost of around £3m. The expansion will double the company's British workforce by creating some 200 new jobs and underlines the capability of Midland-Ross to compete in a fiercely contested market with the industry's multinationals.

Succesful new products, such as Insulation Displacement Connectors, have taken Midland-Ross strongly into one of the fastest-growing sectors of the electronic connector industry.

The £3m investment strengthens the base for launching a major force in the world connector market, which has been developed by Midland-Ross over the past two years. In that period, the company has joined together the strengths of such famous names as Cambion, Hollingsworth Solderless Terminals, SAE Connectors, and Bergey.

Currently, Midland-Ross offers its customers over 80 000 products, including a significant number of state-of-the-art lines. The total range includes printed-circuit board interconnect devices, solderless terminals, splices, and a complete line of electronic hardware.

Midland-Ross Limited
Electronics Connector Division
Castleton
Sheffield S30 2WR
Telephone: (0433) 20831

Amphenol in Hong Kong

Amphenol Products has opened a new 6200 m^2 plant in Hong Kong for the production of flat ribbon cable and selected connectors. Amphenol Products has extensive international manufacturing experience, operating plants in Canada, Great Britain, France, West Germany, and Italy, and through affiliates in Japan and India.

Amphenol Limited
Thanet Way
Whitstable
Kent CT5 3JF
Telephone: (0227) 264411

Monolithic Memories' earnings down

Monolithic Memories Inc reports that sales for its third fiscal 1985 quarter ending 9 June were \$39 390 000 compared with \$45 973 000 for the corresponding quarter last year. Net earnings were \$304 000, or 2 cents per share, compared with 34 cents per share in the third quarter of 1984.

Mr Erwin Federman, President and Chief Executive Officer, said that, with the exception of defence customers, market demands remain weak, reflecting general industry conditions. Intense price competition and a continuing strong dollar have combined to substantially reduce margins. Monolithic Memories is responding to these circumstances by the decommissioning of one wafer production facility, the curtailment of factory schedules, and the implementation of shortened working weeks for all employees. In spite of these measures, he stated that it was unlikely that MMI can continue to operate profitably unless orders pick up in the near future.

Monolithic Memories is one of the leading producers of semi-custom, high performance large-scale-integration <LSI> logic and memory circuits. Founded in 1969, the company employs some 3800 people worldwide.

Monolithic Memories Limited
Monolithic House
1 Queens Road
Farnborough
Hants GU14 6DJ
Telephone: (0252) 517431

Crow and Barco renew agreement

Crow of Reading Limited and Barco Video Communications NV have renewed their picture monitor distribution agreement for a further three years without material change. Under the terms of this agreement, Crow retains the exclusive franchise throughout the United Kingdom for the distribution and service of the entire Barco range of broadcast television picture monitors.

Crow is also UK distributor for Barco HDTV colour monitors, which have been specially developed for use with wide-band high-definition television systems.

Crow of Reading Limited
Hudsons House
264 Bath Road
Slough
Berks SL1 4EF
Telephone: (0735) 31181

Quality first at BICC-VERO

BICC-VERO has joined the select list of manufacturers that have won recognition as BSI Firms of Assessed Capability. The company is the first to be registered by the British Standards Institution for the design and manufacture of electronics enclosures, card frames, and associated accessories, either standard or purpose-built.

BICC-VERO Electronics Ltd
Industrial Estate
Chandlers Ford
Hampshire S05 3ZR
Telephone: (04215) 60211

Coutant top in EPD survey

Coutant Electronics have gained top place in the OEM power supply category of the *Electronic Product Design* preference survey 1985. This survey, conducted by the Techpress Marketing Services Department, covered eighteen manufacturers and involved 2000 readers of *Electronic Product Design*.

Coutant Electronics was formed in 1959 and at present employs almost 300 staff, engaged exclusively in the design and manufacture of power supplies.

Coutant Electronics Ltd
Kingsley Avenue
Ilfracombe
Devon EX34 8ES
Telephone: (0271) 63781

Cirkit to market WPO kits

All marketing and distribution of the well-known WPO Communications range of amateur radio kits is now carried out by Cirkit Holdings PLC, who are already a market leader in kits and modules for electronic constructors.

Cirkit already stocks the twenty-five most popular WPO lines; the remainder will become available from January 1986.

Cirkit Holdings PLC
Park Lane
Broxbourne
Herts EN10 7NQ
Telephone: (0992) 444111

Racal in Italy

Racal-Redac, a world leader in computer-aided design systems for the electronics industry, is expanding its European activities with a new sales operation in Italy.

As well as opening a new office in Milan, Redac has also appointed Tele Communications System SpA of Milan as a system distributor. Tele Communications SpA has considerable experience in the industry, and will focus on the sale of two new systems ideal for the Italian market.

Redac, which started twenty years ago with the development of computer-aided design <CAD> systems for printed-circuit board design, now has over 2300 installations around the world. In Europe, successful operating subsidiaries in West Germany, France, Scandinavia, and the Netherlands have enabled the company to capture over 35 per cent of the market.

Redac's Milan office will be fully supported by Racal-Redac SA, based in Paris, which has already established itself as a successful supplier to the French market with nearly 200 installations.

Racal-Redac Limited
Tewkesbury
Gloucestershire GL20 8HE

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CA 3085 TO99 Variable regulator ... **£ 1.00**
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2N3055 Motorola .... **50 p 5/£2.00**
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12FR400 12 A 400 v small stud ... 4/**£ 1.50**
BY 127 1200 v 1.2 A .... 10/**£ 1.00**
BY 254 800 v 3 A .... 8/**£ 1.00**
BY 255 1300 v 3 A .... 6/**£ 1.00**
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6 A 100 v bridge **50p**
10 A 200 v bridge .... **£ 1.50**
15 A 100 v bridge .... **£ 1.50**
25 A 200 v bridge . ea. **£ 2.00** 10/**£ 18.00**
25 A 400 v bridge ..... **£ 2.50** 10/**£ 22.00**

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BTX95 800 v 15 A .... **£ 1.50**
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2N5061 800 mA 60 v TO92 .... 4/**£ 1.00**
TICV 106D .8 A 400 v TO92 3/**£ 1** 100/**£ 15.00**
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W22 or sim. 6 watt
7 of one value for .... **£ 1.00**
R47, 1R5, 9R1, 10R, 12R, 20R, 33R, 51R, 56R, 62R, 120R, 180, 270R, 390R, 560R, 620R, 1K, 1K2, 2K2, 3K3, 3K9, 10K

W23 or sim. 9 watt
6 of one value for .... **£ 1.00**
R22, 1R0, 3R0, 6R8, 56R, 62R, 100R, 220R, 270R, 390R, 680R, 1K, 1K8, 10K

W24 or sim. 12 watt
4 of one value for .... **£ 1.00**
R50, 2R0, 10R, 18R, 47R, 68R, 75R, 82R, 150R, 180R, 200R, 270R, 400R, 620R, 820R, 1K.

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2N5777 .... **50p**
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1N5401 3 A 100 V .... 10/**£ 1.00**
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33n/47n 250 V AC X rated rad 15 mm 10/**£ 1.00**
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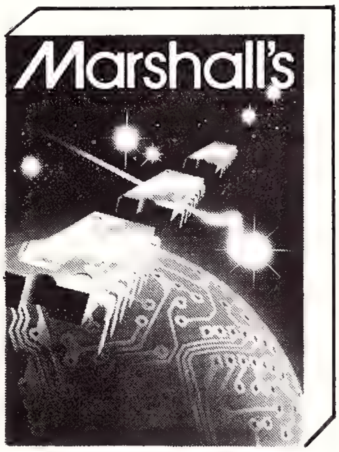

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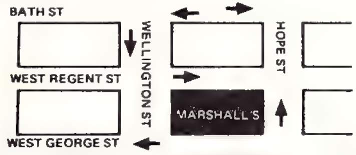

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HART

This month we feature some fantastic bargains Our standard range of professional quality kits and cassette decks is still expanding, along with new lines in Video heads and power supplies Our FREE list gives details of these and many other lines ALL BARGAIN ITEMS IN THIS & THE NEXT COLUMN INCLUDE VAT & POST

MODEM OPTICAL ISOLATOR UNIT

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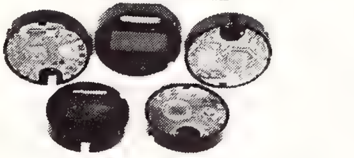

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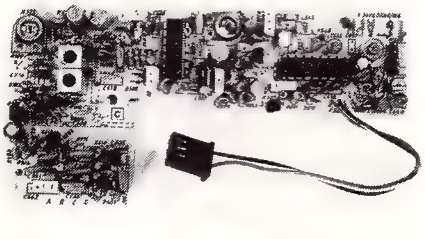

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Please consult our list for technical data on these and other Special Purpose Heads.
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electronics select

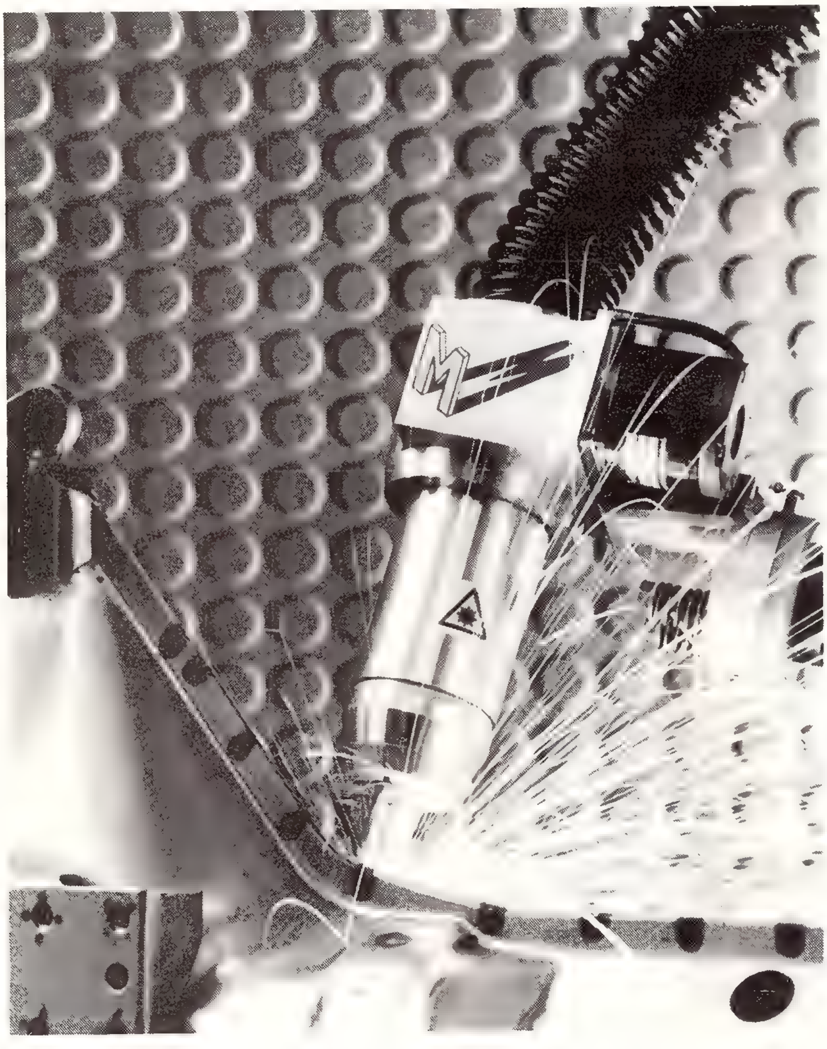
A second generation of robots

The employment of first generation robots without any sensory power has been described as employing deaf, dumb, blind, one legged human operators with their single foot nailed to the ground. Early applications such as spraying and spot welding required relatively low accuracy of arm positioning, and even machine loading was based on an accurate location point or fixture outside the control of the robot itself.

However, equipment is now being developed to provide such senses as sight, feel, and even smell. In the security field, for example, research is taking place on sensors that can recognize odours given off by explosives.

At London's Imperial College, a robot has been developed that detects the position of bones in sides of bacon before removing them — although much more slowly, so far, than can be done by a butcher.

In the drive towards more automation and the manufacture of high quality products, British companies are looking closely at what artificial vision systems can offer. Such is the interest that a new book, *Machine Vision* by J Hollingum, has just been published by IFS Publications, which is an associate company of the British Robot Association. Written in conjunction with British Robotic Systems, it reviews the scope for applications and suggests ways for companies to embark on the use of artificial vision.



Using a combination of lasers and miniature cameras, the MetaTorch accurately accommodates variations in seam width and direction during robot arc welding operations.

Sensory Feedback

In the Department of Electronic Engineering at the University of Hull, there is an expanding programme of robotic studies, with over £330 000 received this year in contracts and grants. The main area of work is concerned with the integration of sensory feedback into robotic assembly systems. The exploitation of information obtained from a large number of sensors within an environment allows the work-station to cope with an increasingly disorganized state, thus relaxing many of the otherwise stringent and expensive requirements for fixtures.

Experience with analysis and implementation of robotic systems has shown that a set of well chosen "simple" sensors can provide all the information necessary for the system to determine the success of an attempted assembly. Such a capability is essential for truly flexible automation.

The department has developed a camera system of low resolution (up to 256×128 pixels), which is particularly suitable for such purposes as component inspection and identification. The use of a low cost dynamic random access memory chip as a light sensor provides a means of imaging not normally obtainable by other means.

While video cameras normally used for recording are based on charge coupled devices and cost up to £2000, the Hull University camera will cost about £100 — including interface with the robot's computer control. Its low resolution is quite adequate for robot assembly applications and simple quality control inspection.

Linear Array Processor

Formed nearly four years ago, British Robotic Systems has concentrated on the application of vision systems to enhance manufacturing processes. Its first system, the Autoview Viking, is based on a linear array processor developed in conjunction with the National Physical Laboratory. The company has recently developed a more advanced system known as the Viking XA.

The original Viking system consists of an industrial television camera, a minicomputer, a monitor, interface hardware, and a command console. Specialized handling equipment and illumination to suit the application is available. By analysing the image produced by the camera, the system can automatically identify the characteristic shapes of manufactured parts and their position, orientation, and textural features, so that quality can be confirmed or the next operation in a process initiated. The sensors do this

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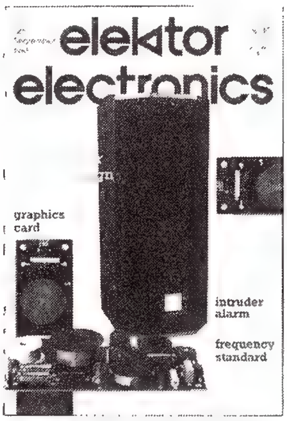

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Beaufort scale	Description	Wind speed		
		m/s	mph	knots
0	calm	0. . .0.2	0. . .1	0. . .1
1	light air	0.3. . .1.5	1. . .3	1. . .3
2	light breeze	1.6. . .3.3	4. . .7	4. . .6
3	gentle breeze	3.4. . .5.4	8. . .12	7. . .10
4	moderate breeze	5.5 . .7.9	13. . .18	11. . .16
5	fresh breeze	8.0. . .10.7	19. . .24	17. . .21
6	strong breeze	10.8. . .13.8	25. . .31	22. . .27
7	moderate gale	13.9. . .17.1	32. . .38	28. . .33
8	fresh gale	17.2. . .20.7	39. . .46	34. . .40
9	strong gale	20.8. . .24.4	47. . .54	41. . .47
10	whole gale	24.5. . .28.4	55. . .63	48. . .55
11	storm	28.5. . .32.6	64. . .75	56. . .65
12	hurricane	32.6 +	75 +	65 +

---

elektor electronics datacard | transistors: BF450 & BF451

type

p-n-p transistors for use in radio frequency circuits; BF450 for controlled stages; BF451 for uncontrolled stages

characteristics

Collector cut-off current, I_{CBO}	
($-U_{CB} = 30$ V)	$\leqq$ 50 nA
($-U_{CB} = 40$ V)	$\leqq$ 10 μA
base-emitter saturation voltage, $-U_{BE}$ ($-I_C = 1$ mA; $-U_{CE} = 10$ V)	typ 0.7 V
current gain - bandwidth product, f_T ($-I_C = 1$ mA; $-U_{CE} = 10$ V)	typ 325 MHz
DC current gain <BF450>, h_{FE} ($-I_C = 1$ mA; $-U_{CE} = 10$ V)	$\geqq$ 60
DC current gain <BF451>, h_{FE} (($-I_C = 1$ mA; $-U_{CE} = 10$ V)	$\geqq$ 30
noise figure, NF ($-I_C = 1$ mA; $-U_{CE} = 10$ V; $R_S = 300$ $f = 100$ kHz)	typ 2 dB

data are valid only under the conditions stated in brackets

limits

$-U_{CBO}$	40 V
$-U_{CEO}$	40 V
$-U_{EBO}$	4 V
$-I_B$	5 mA
$-I_{CM}$	25 mA
P_D	250 mW1)
T_j	150°C
$R_{th(j-a)}$	42 K/W

1) up to $T_a = 25$°C; derate above 25°C by 2.88 mW/°C)

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The principal cause of movement in the atmosphere is difference in density, which is due to differences in temperature and pressure. When air comes into contact with a source of heat, its gets hotter, expands, becomes less dense, and rises. The place vacated by the displaced air is taken by colder air, so that convection currents are set up. Generally, this moving air will tend to move to an area where the density is of the same order as its own. The consequent large-scale movement is air is termed wind.
Wind is characterized by force and direction. The wind force is measured with an anemometer and expressed in metres per second, miles per hour, or knots; it is also commonly quoted as a number on the Beaufort scale (see reverse of this card).
Wind direction is normally determined with a wind vane, consisting of an arrow pivoted at its centre on a vertical axis, below which fixed pointers indicate the four cardinal points.
The kinetic energy of the moving air is $P = \frac{1}{2}\varrho A v^2$, where ϱ is the density, A is the cross-sectional area of the air stream, and v is the force of the wind in metres per second. The maximum energy that can be gained from wind is approximately sixty per cent of the kinetic energy.
The wind pressure, i.e., the force exerted on an object by the wind, is directly proportional to the surface at right angles with the direction of the wind and to the square of the force of the wind.

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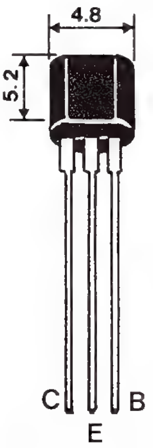
elektor electronics datacard | transistors BF450 & BF451



dimensions in mm

input capacitance, C_i	(BF450 at 450 kHz)	typ 20 pF
	(BF450 at 10.7 MHz)	typ 13 pF
	(BF451 at 450 kHz)	typ 30 pF
	(BF451 at 10.7 MHz)	typ 20 pF
output capacitance, C_o		typ 1 pF
common emitter feedback capacitance, C_{re}		typ 0.35 pF
base current, I_B	(BF450)	5...16 μA
	(BF451)	11...33 μ A
($-I_C = 1$ mA; $-U_{CE} = 10$ V)		
emitter cut-off current, $-I_{EBO}$ ($-I_C = 0$ mA; $-U_{EB} = 4$ V)		10 μA

D 19

by measurement and comparison of key features and such parameters as area, radius, centre of gravity deduced from two dimensional measurements, and surface contours.

Recently accomplished tasks include automatic character reading and checking, component measurement, component indentification and orientation, automatic crack detection and parts retrieval and machine loading from a bin.

The Viking XA includes an additional set of powerful software commands incorporating a PROLOG artificial intelligence (AI) language interpreter, which introduces expert system based "help" functions and AI techniques. The system has full 512×512 pixel resolution, an extended memory of 256 Kbytes, and an option for real time processing through the use of the linear array processor.

Robot Arc Welding

Having employed first generation robots in paint spraying, spot welding, and similar unpleasant jobs, it would seem most attractive to extend their use to arc welding. However, new problems arise in this application since the seam to be welded may vary slightly in width and direction. Work at Oxford University has resulted in a visual sensor that solves this problem. To exploit the development commercially, the university has set up Meta Machines to build and market the MetaTorch arc welding robot, which derives its "sight" from a compact combination of lasers and miniature cameras. These look a short distance ahead of the welding torch to locate the precise position of the joint, and the gap and offset of its edges.

The information gathered, after complex vision and geometric processing, is passed to the robot arm and welding set. These enable the torch to follow the course of the joint exactly, and automatically adjust the welding conditions to secure a strong weld. As a result of this continuous feedback of information, the MetaTorch is able to cope with irregularity in the joint caused by factors such as wear in location pins and fixtures, imperfect components, and the unpredictable springback of pressed sheet metal. The robot can even cope with changes caused by thermal distortion with occur during the course of a weld.

Although vision systems may speed up the application of robots to assembly operations, the design of products to suit production can increase robot efficiency without resorting to the inclusion of vision sensors. Some years ago, forklift truck manufacturer Lansing engineered a Unimate Puma robot without vision to produce wire harnesses used in the connection of electrical circuits in its trucks. More recently, BP Solar Systems has developed an assembly work-station for its solar panels, of which it produces 5000 a year. This is also engineered around a Puma robot manufactured by Unimation Europe and operates efficiently without vision.

Vacuum Grippers

Thought to be the only one of its type, the assembly robot commences its sequence by pneumatically picking up a fragile solar cell disc, using one of two vacuum grippers. It then orientates the cell with an indexing mark printed on the disc face and solders conductive leads to the cell. The leads are then cut and crimped to allow for subsequent expansion and contraction. After cooling, the cell is placed on a source of intense light and its electrical output is monitored to ensure that it meets the required level of performance. Finally, it is placed in one of thirty-six positions on an assembly table with its leads correctly positioned.

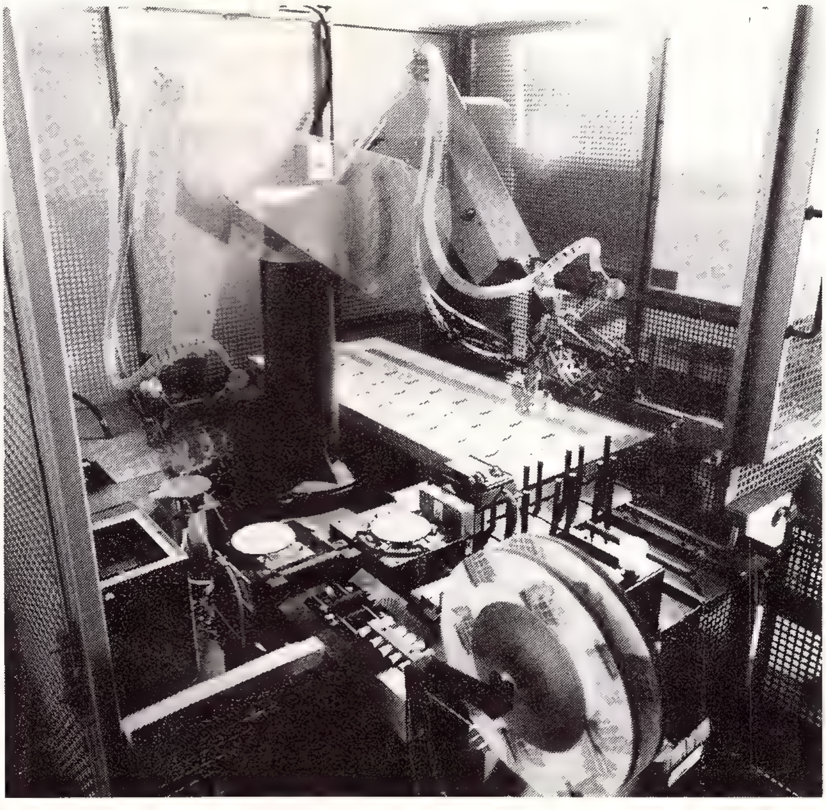
When all thirty-six cells have been placed in position, the robot employs two hot air guns to solder the cells together into a continuous circuit. The entire process takes about 50 minutes.

Many people regard vision and other senses as the most promising properties in the robot market. Undoubtedly, intelligent robots will help to overcome the problems of the disorganized state of an assembly station where components have been designed for human assembly.

In some areas it may be more economic to design the components and the assembled product specifically for handling by a robot without visual or tactile senses.

(LPS)

by Arthur Fryatt



A multi-exposure photograph showing movement of the Unimate Puma robot arm during the assembly of solar panels. The complex nature of the component handling devices engineered by BP Solar Systems can be clearly seen.

electronics select

The thinking computer

The fifth generation computer will soon be with us. But what exactly is this wondrous device whose development costs over the next 20 years will run internationally into thousands of millions of pounds?

In fact it is not necessarily a computer at all, at least in terms of the present generation of work-stations, processors, and peripherals.

It could be a robot able to distinguish between the circuit board it is supposed to be picking up and the lunchtime sandwich of the maintenance engineer, inadvertently left lying beside the production line. It could be a computer that talks and questions a management decision made when an executive is having an offday. Or it could be an expert in any subject known to man.

Basically, though, it is a concept to amplify the intellectual brain power at the command of the worker of the next generation. It will accomplish this by an order of magnitude equivalent to the power that James Watt's steam engine provided for the workers of the first Industrial Revolution.

Steam Engine

The analogy with one of Scotland's greatest contributions to the modern world is more than coincidental. Just as the steam condenser was the key that unlocked the power of the steam engine, a programming language called **Prolog**, developed from work undertaken at Edinburgh University, is being used as the kernel artificial intelligence language by a large number of research groups in different parts of the world.

Over the past 20 years, against heavy odds and with minimal funding, the pioneering group of artificial intelligence computer engineers from Edinburgh has been held together largely through the determination of one man — Professor Donald Michie.

Recently, the team moved to a new office complex in Glasgow. Here it aims to establish a European centre for training and development in expert systems, machine induction, computer vision, and advanced robotics, which are the core technologies of the fifth generation computer.

Code Cracking

With funding from the Scottish Development Agency and with the backing of Strathclyde University, which appropriately owes its origins in part to James Watt, the professor and his team have set up the Turing Institute, named after the mathematician Alan Turing.

He was responsible for the pioneering work on computing done at Bletchley Park during World War II, which contributed to the cracking of the German Enigma codes. Professor Michie was one of Turing's young colleagues.

The Japanese decision to set up a fifth generation computer project in 1982, involving eight major companies and two national laboratories with government and private funding, gave impetus to the fifth generation concept and sparked off the race to conquer the technology.

The computer has been around for 40 years, but it is still a crude machine. It cannot understand normal speech or writing.

Today's machines do exactly what they are told — no more, no less. The aim is to produce a computer that can acquire knowlegde and use it intelligently.

There is now considerable haste in the West to launch programmes to support computer research, and examples are the European **Esprit** programme and Britain's **Alvey** project, and various schemes in the United States of America.

Private Funding

The Turing Institute, apart from relatively modest financing from the Scottish Development Agency, has taken the entrepreneurial approach with private funding and will raise the finance needed for its advanced research and development work by offering its unique knowlegde, its teaching capabilities, and its research facilities to individual companies and institutions through a system of industrial affiliates.

Under this subscription system, companies pay for a range of facilities and can send employees to be tutored on artificial intelligence systems for applications in their own companies.

During 1983, the institute planned for eight affiliates, all from Europe. They include GMD of Bonn, ICL, two Shell laboratories, Sinclair Research, and Thorn-EMI. The latter recently took over INMOS, the semiconductor company that has developed the transputer. It is a complete computer on a single chip, and is an essential element in the fifth generation development.

The reputation of Professor Michie's team has also attracted three United States organizations, including Westinghouse Electric, to sign up under the terms of a recently created "remote affiliate" category.

Hands On Experience

The training programme for staff seconded on a long term basis involves formal instruction and hands-on experience. Formal instruction comes under three main headings of inference systems and logic programming, which are the basic underpinnings of the techniques used in the development of expert systems; computer vision, which takes in the principles of how a robot can be taught to recognize whatever is put before it, such as distinguishing between a circuit board and a sandwich; and expert systems and robot planning.

The institute was a pioneer of the use of inductive learning and is a world leader in the field. This involves literally teaching the computer to learn for itself on the basis of its cumulative acquired knowlegde. At the Turing Institute, inductive programming is the basis for expert systems, computer vision, and robitics.

Affiliates also have access to extensive library facilities and to the research work of the institute. The institute organizes regular industrial seminars on individual aspects of artificial intelligence. Short courses and individual tutorials are planned to spread expertise in artificial intelligence systems into industry and commerce on an international level.

Expert Knowlegde

Dr Tim Niblett, director of industrial studies and the executive responsible for the scheme said: "As an institute we are focusing our attention on the synthesis of expert knowlegde. By transferring an expert's knowledge to a computer, the potential impact on society is at least as great as printing in relation to the book.

"At the moment it is an extremely difficult craft and the stage we are at now is where computing was 25 years ago. Asking what the problems are is really like asking what the problems are in the study of particle physics. Basically, it is making a computer understand ordinary concepts with all the complexities of meaning, syntax, and implications.

"The first generation of artificial intelligence programs involved a computer specialist putting all the knowlegde of an expert into the computer by hand. We are now at the second generation, where the expert inputs his knowlegde by showing examples of expert decisions. From these examples the artificial intelligence system hypothesizes expert rules, which then becomes accessible to any authorized person simply by asking the machine questions.

"So the expert knowlegde is then available at all times, without the expert having to be physically present."

The institute has already been directly involved in the first inductive learning expert system that can be used on microcomputers. The **Expertease** program is being marketed worldwide by an Edinburgh company, Expert Software International, which funded Professor Michie's consultancy company to develop the basic program commercially.

Good Potential

Dr Niblett added: "**Expertease** is a second generation product, with good potential in a number of areas such as diagnosis of faults, company procedures and education, but its range is limited and we are now working on very much more sophisticated systems.

"Inductive learning is a way of asking the computer to induce rules on the basis of how an expert in a subject displays his skills. Many experts do not know how they make a decision. The Expert System Program is designed to induce the rules by which the expert arrived at a particular decision.

"The expert merely puts in statements of fact from his own knowlegde. At its simplest it would go something like this: 'It is raining. I will take an umbrella. It is cold. I will put on a coat'. The computer therefore induces the rule that rain requires an umbrella and cold a coat, and if it is cold and raining take both. Even at that simple level, the expert has not sat down and worked out how he came to the decision. It was common sense, but it is very difficult to teach a computer common sense."

Present day programs are totally inflexible. Given a task, the computer will attempt to pursue it to its conclusion even if the task is impossible. The fifth generation systems will pursue it by working out the best alternative to achieve the result required in the same way that the human mind works.

Initially, the Turing Institute will have a staff of around 15, plus seconded staff from affiliate subscribers. One of the priorities is to attract world specialists in the field — many of whom left Britain in the years when artificial intelligence was a poor relation of computing science. Through its association with Strathclyde University, the institute will have access to one of the largest and most advanced computer science departments in the country. The department is also involved in **Esprit** projects.

Next year, the institute hopes to double the number of affiliates. A proposal has been put to the **Alvey** project directorate to contribute to the training costs of affiliate employees, and the institute will begin promoting the scheme seriously in the United States.

Body Of Expertise

Dr Niblett added: "The growth of artifical intelligence systems over the next few years will be limited only by the number of people able to utilize the technology. With the affiliate scheme, companies can second one person at a time over a year or two for six months each, building up a body of expertise within the company.

"These people will then be able to take some of the 'shell' artificial intelligence programs and develop them for particular applications within a company. There has been tremendous interest in the affiliate scheme despite the fact that we have not really gone out to market it yet. The American response was particularly encouraging.

"I would estimate that within five years expert systems will have reached a stage of development in power and cost effectiveness to attract the mass user. Then the market will really begin to take off. At present, the cost of artificial intelligence is high and we are still in the early stages of developing the programming. It is a new style of programming and a new set of problems.

"In Britain the demand for home computers has been the highest in the world. Once expert systems can be allied to that market there is no knowing in what direction knowlegde-based systems will go.

"In the fairly near future, I would expect to see people starting to sell knowlegde bases either for use individually or using a centralized computer you can dial up for expert advice. The applications are limitless, but certainly medicine and education are two areas with enormous potential."

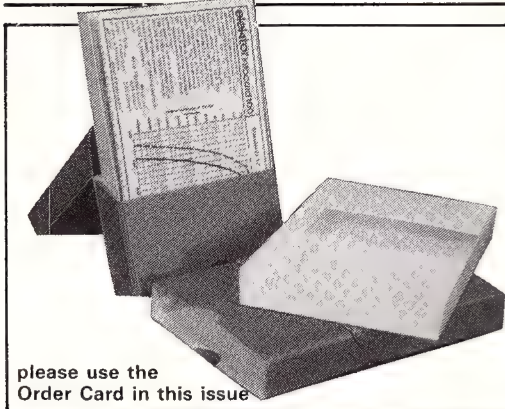
The Japanese fifth generation project is impressive in its scale and its integration. But the Turing Institute will play its part for Britain and Europe generally.

From a Scottish point of view, the institute, combined with projects such as the £3 million Alvey research and development programme at Edinburgh University on the speech driven word processor, gives the Scots the opportunity to contribute as much to the second industrial revolution as they did to the first.

(LPS)

by Maurice Baggott

Professor Donald Michie.



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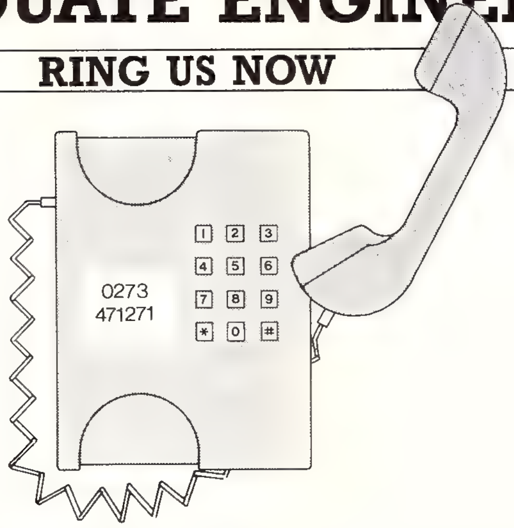

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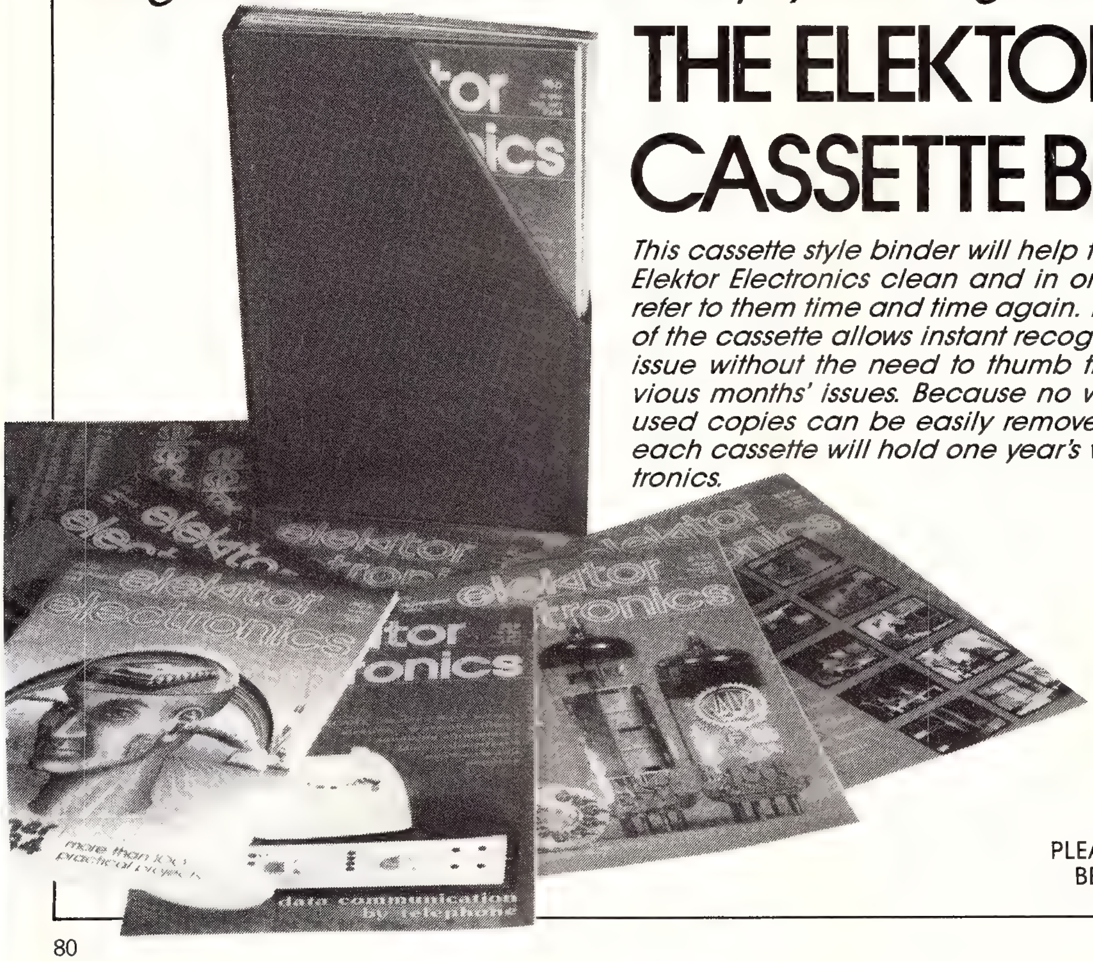

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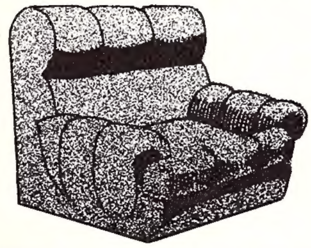

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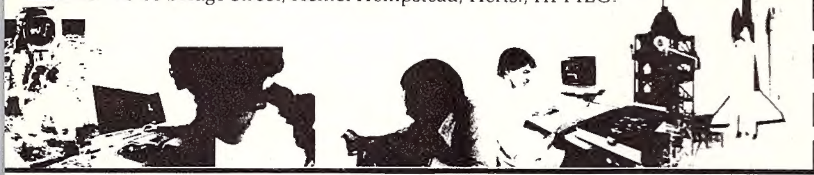

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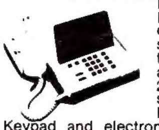

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2.	(2)	◆◆	75W Mosfet Amp.	LW51F	£15.95	Best E&MM
3.	(3)	◆◆	Car Burglar Alarm	LW78K	£7.49	4 XA04E
4.	(7)	◆	Logic Probe	LK13P	£10.95	8 XA08J
5.	(5)	◆◆	U/sonic Intrudr Dtctr	LW83E	£10.95	4 XA04E
6.	(4)	◆	Partylite	LW93B	£10.95	Best of E & MM
7.	(6)	◆	8W Amplifier	LW36P	£4.95	Catalogue
8.	(–)	◆	Noise Gate	LK43W	£9.95	Best E&MM
9.	(9)	◆◆	Computadrum	LK52G	£9.95	12 XA12N
10.	(–)	◆	DXer's Audio Processor	LK05F	£9.85	7 XA07H

Over 100 other kits also available. All kits supplied with instructions. The descriptions above are necessarily short. Please ensure you know exactly what the kit is and what it comprises before ordering, by checking the appropriate Project Book mentioned in the list above.

Is it a turtle?
Is it a robot?
Is it a buggy?
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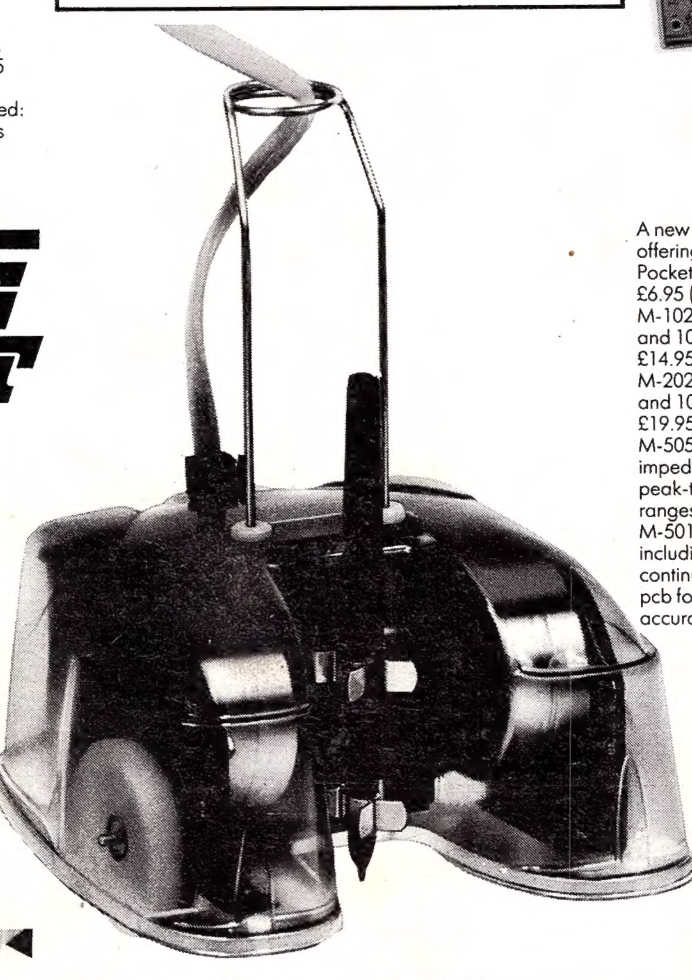

- ■ May be used by any computer with RS232 facility.
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- ■ Half millimetre/half degree resolution.
- ■ Uses ordinary felt-tip pens.
- ■ Built-in 2-tone horn, line-follower. LED indicators.

The Zero 2 Robot is the first truly micro robotic system available and remarkably it costs less than £80. Complete kit (only mechanical construction required) £79.95 (LK66W).
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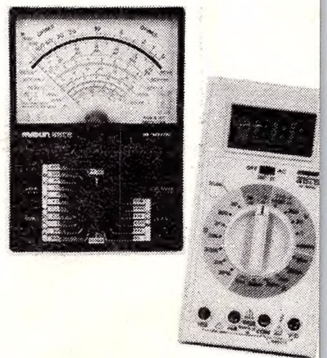

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